Camp Robin

Hydrology Report

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for:
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Introduction

Proposed activities (Alternative 2) for the Camp Robin Project (CRP) include timber harvest, fuels reduction treatments (prescribed burning and piling), tree planting, and road system modifications (temporary road construction, existing road reconstruction, maintenance, storage and decommissioning/blocking access), including replacing/removing culverts and removing a barrier to aquatic organisms. This project also proposes to improve aspen and riparian vegetation communities found in what is termed in the EA as Special Treatment Areas (STA's). The focus of this report is to document existing conditions of hydrologic resources, associated aquatic habitat and beneficial uses in the project area and to analyze potential environmental effects of the proposed activities. A description of the project area, purpose and need and proposed action can be found in the CRP Environmental Analysis (EA).

The dissected nature of the landscape in and around the project area allows for relatively small portions of the overall project area containing proposed activities to fall within 6 different 6^{th} level watersheds (see Table 2). Table 1 displays the issues relevant to water resources in the CRP area and the indicators used to measure effects.

Summary of Analysis

This project is consistent with and complies with the 2015 IPNF Forest Plan and all other applicable laws, policy and regulation related to water resources and water quality (W-3). The activities proposed in this project are unlikely to produce more than minor short-term water resource effects would not damage or degrade watershed resources including stream channels and/or aquatic habitats. This project would not adversely affect water resources due to the inherent site characteristics (geomorphological processes), stream channel form and function, operational limitations and design features. Best Management Practices (BMPs) and design features would be used to specifically minimize potential for soils and water quality disturbances and would greatly reduce potential for erosion, sedimentation or reduced water quality. All forest management that proposes timber harvest would include leaving required levels of coarse woody debris on the ground to protect and maintain soils productivity and regenerate more resilient native tree species which would minimize negative water resource effects.

A coarse screen suggests that the project area boundary and its contained streams or near-by distinct catchment areas of; Round Prairie Creek, Gillon Creek, Mission Creek, Meadow Creek, Brush Creek, Rock Creek and a section of the Moyie River in which the proposed vegetation treatment as well as proposed road management, road/culvert removal and most water quality improvement would occur, warrants the appropriate area for in-depth effects analysis. According to the 2012 and draft 2014 Idaho Department of Environmental Quality (IDEQ) Sub Basin Assessments, no streams within the project area are Clean Water Act (303d) listed for sediment impairment and the aforementioned streams are currently providing for beneficial uses (W-1). There are two small community water associations or municipal water uses in the project area but they will not be negatively impacted by the proposed activities (W-2). The proposed action would reduce overall riparian road densities which would reduce potential for sedimentation to streams. Streams in the project area are currently functioning well overall and would likely remain resilient and stable even if short term water yield fluctuation occur.

All practical measures to minimize sediment production are included in the action alternative including water resource protection in the planning, design and implementation phases. Implementation of the proposed roads closures, road decommissioning and the removal of a fish barrier and high sediment risk culvert in Wall Creek along with the use of BMP and drainage upgrades on reconstructed roads would reduce sediment in the project area in the short-term and long-term time frames.

Relevant Laws, Regulations, and Policy

Regulatory Framework

Land and Resource Management Plan

The Idaho Panhandle National Forests Land and Resource Management Plan (the Forest Plan) guides all natural resource management activities and establishes management direction for the Idaho Panhandle National Forests. The 2015 Forest Plan includes direction for the maintenance and improvement of water quality and aquatic habitats. Forest Plan components that may be applicable to the watershed, soils, riparian, aquatic habitat, and aquatic species resources are found on pages 22-29 and appendix B of the Forest Plan. See (W-3) for detailed documentation regarding forest plan CRP compliance with regard to watershed, hydrology and aquatic habitat.

Table 1. IPNF Land Resource Management Plan applicable standards and guidelines for water resources (riparian, wetland and aquatics)

Standard or Guidance	Description
FW-GDL-RIP-01	Soil and snow should not be side-cast into surface water during road maintenance operations.
FW-GDL-RIP-05	If necessary for the attainment of RHCA desired conditions, ground-based logging equipment should only enter an RHCA at designated locations.
FW-GDL-WTR-01	Ground-disturbing activities in subwatersheds with Category 5 water bodies, on Idaho's §303(d) list of impaired waters, should not cause a decline in water quality or further impair beneficial uses. A short-term or incidental departure from state water quality standards may occur where there is no long-term threat or impairment to the beneficial uses of water and when the state concurs. Category 5 water bodies are waters where an approved TMDL is not available.
FW-GDL-WTR-02	In order to avoid future risks to watershed condition, ensure hydrologic stability when decommissioning or storing roads or trails.
FW-GDL-VEG-09	Peatlands/bogs should be buffered by at least 660 feet from management activities that may degrade this habitat.
FW-STD-WTR-01	Ground-disturbing activities in source water areas (designated special or public water supply watersheds) shall prevent risks and threats to public uses of water. Short-term effects 1 from activities in source water areas may be acceptable when those activities support long-term benefits 2 to the RHCAs, soils, and aquatic resources.
FW-STD-RIP-01	When RHCAs are intact and functioning at desired condition, then management activities shall maintain or improve that condition. Short-term effects3 from activities in the RHCAs may be acceptable when those activities support long-term benefits4 to the RHCAs and aquatic resources.
FW-STD-RIP-02	When RHCAs are not intact and not functioning at desired condition, management activities shall include restoration components that compensate for project effects to promote a trend toward desired conditions. Large-scale restoration plans or projects that address other cumulative effects within the same watershed may be considered as compensatory components and shall be described during site-specific project analyses.

FW-STD-RIP-03	The INFISH direction in the Decision Notice (USDA Forest Service, 1995) and terms and conditions in the Biological Opinion (USFWS, 1998), and shall be applied with the following clarifications (see appendix B IPNF Forest Plan): • The description of Standard Widths Defining Interim RHCAs is consistent for all Category 4 streams or water bodies: The area from the edges of the stream channel, wetland, landslide, or landslide-prone area to a distance equal to the height of one site-potential tree, or 100 feet slope distance, whichever is greatest; and • TM-1 applicable INFISH "standards and guidelines" is defined as a standard in the 2015 IPNF Forest Plan.
(applicable standard) TM-1	(b) Apply silvicultural practices for RHCAs to acquire desired vegetation characteristics where needed to attain RMOs. Apply silvicultural practices in a manner that does not retard attainment of RMOs and that avoids adverse effects on inland native fish.

Federal Law

Clean Water Act

The Clean Water Act requires the states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. Stipulations in the Clean Water Act require the Environmental Protection Agency (EPA) and the States to develop plans and objectives that will eventually restore identified stream segments of concern. The Clean Water Act (CWA) requires all water bodies that are deemed to be not fully supporting their beneficial uses by the state (Idaho and Washington) be brought onto the 303(d) list as water quality limited. For waters identified on this list, states must develop a Total Maximum Daily Load (TMDL) for the pollutants set at a level to achieve water quality standards.

National Forest Management Act

Section 6 of NFMA provides language to "insure that timber will be harvested from National Forest System lands only where; soil, slope, or other watershed conditions will not be irreversibly damaged; protection is provided for streams, stream-banks, shorelines, lakes, wetlands, and other bodies of water from detrimental changes in water temperatures, blockages of water courses, and deposits of sediment, where harvests are likely to seriously and adversely affect water conditions or fish habitat; and that such [harvests] are carried out in a manner consistent with the protection of soil, watershed, and fish, resources.

Executive Orders

Protection of Floodplains, Executive Order 11988

Requires federal agencies to avoid to the extent possible the long and short-term adverse impacts associated with the occupancy and modification of flood plains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative.

Protection of Wetlands, Executive Order 11990

Directs federal agencies to provide leadership and shall take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

State and Local Law

Idaho Forest Practices Act

The Idaho Forest Practices Act regulates forest management on all ownerships in Idaho, including National Forest System lands (Title 38, Chapter 13, Idaho Code 2000).The Forest Service has agreements with the state to implement best management practices (BMPs) for all management activities. All activities would meet or exceed guidelines described in the Soil and Water Conservation Handbook (Forest Service Manual 2509.22)

Idaho Stream Channel Protection Act

The Idaho Stream Channel Protection Act requires that the stream channels of the state and their environment be protected against alteration for the protection of fish and wildlife habitat, aquatic life, recreation, aesthetic beauty and water quality. The Stream Channel Protection Act requires a stream channel alteration permit from Idaho Department of Water Resources before any work that would alter the stream channel may begin.

Topics and Issues Addressed in This Analysis

Resource Indicators and Measures

Table 1. Resource indicators and measures for assessing effects to hydrology and aquatic habitats.

Resource Indicator	Measure (Quantify if possible)
Water Quality (Sediment Delivery Potential)	Field & Literature Reviews, Road and Stream map analysis with GIS, aerial photography, assessment review of BMP effectiveness, WEPP (Watershed Erosion Prediction Project, *Elliot, et al 2001, 2002*) erosion and sedimentation models and changes in open road densities. Riparian miles of road per square mile (mi/ mi^2).
Water Quality (Stream Temperatures)	Riparian vegetation preserved or improved (acres).
Watershed Function (Stream Channel and Wetland/Peatland Stability)	Field & literature, GIS data for stream analysis, GIS data (forest canopy changes over time, aerial photography, range of natural variability discussion and discussion regarding potential water yield changes due to vegetation treatments and/or canopy openings, stream channel stability investigation and assessments, Proper Functioning Condition Assessment (*PFC – Technical Reference 1737-15 1998*) on major streams within the project area.

Water Quality

Sediment Delivery

Sediment yield to streams is a natural process and are associated with events such as wildfires, landslides and floods. These events can deliver tremendous amounts of sediment but are stochastic in nature and occur infrequently over time. (*Moody and Martin 2009*) reviewed post-wildfire literature and found mean sediment delivery amounts from hillslopes of 82 tons/ha with even larger yields from channels. Aquatic ecosystems on the forest have evolved within the context of these kinds of stochastic events, e.g. the wildland fire of 1910.

Forests generally have very low erosion rates unless they are disturbed (*Elliot et. al. 2000*). Common disturbances include timber harvest operations, roads, prescribed burning, and wildfires. Impacts to soil erosion from these activities last a few years before rapid revegetation covers the surface with protective plant litter (*Elliot 2004*). However, not all impacts to soil erosion are short lived. Numerous research studies have documented that forest roads are usually the leading contributor of sediment to stream channels (*Duncan et al. 1987, Bilby et al. 1989, Gucinski et al. 2001*).

Forest roads can be chronic sources of sediment because; road construction, use, and maintenance compact soils, reduce infiltration, intercept and concentrate surface and subsurface runoff, and limit growth of vegetation. Road ditches can be a direct conduit of sediment from ditch and road erosion into live water bodies. Also, roads can increase the frequency and magnitude of mass wasting especially if located on sensitive landtypes.

Road densities can provide a relative measure of road-stream interaction and the relative risk for increased flows and sediment input into the hydrologic system. Road density is sometimes used as a proxy for impacts to streams and watersheds and has been shown to generally reduce fisheries composition and persistence with higher densities. A review of research in Idaho and elsewhere concluded that non-channelized runoff from roads has a low probability of traveling further than 300 feet (*Belt. et al. 1992*). Road densities located with 300 feet of streams, or the hydrologic road density are at greater risk for flow modification and sediment loading.

Log-haul on road segments is not expected to damage adjacent stream channels directly, indirectly over the existing conditions given the limited amount of live stream crossings and the use of BMP such as road maintenance/improvements, dust abatement and operational limitations such as road closures and haul suspension during wet periods and/or storm events which would greatly reduce potential for sedimentation caused by log- haul on roads within the project area (W-4). Therefore the effects of log hauling will not be discussed further in this analysis.

Water Temperature

Native aquatic species require cool stream temperatures to live and persist within the project area. Elevated stream temperatures can result from both natural and human-caused events. Land management (human activity) can increase stream temperatures by removing vegetation along streambanks, which reduces the amount of shade over the water thereby increasing the amount of solar radiation reaching the stream. Stream temperature can also be elevated by excessive sedimentation (i.e., build-up of boulders, rocks, gravel, sand, dirt, and silt), which results in a stream becoming wider and shallower, making it harder to shade and easier to heat. Sediment is a natural part of a stream system, but land management activities like road building, agriculture, forestry, and urban development can increase the amount of sediment entering a stream, delivering higher amounts of sediment than the stream can handle.

The water temperature TMDL’s for the project area streams indicate that preserving or improving riparian shade and restoring natural channel widths are recommended as the primary activities for implementation of the temperature TMDL (W-1).

The surrogate measure for water temperature is area of riparian vegetation preserved or improved is used because direct incoming solar radiation is the dominant energy input for increasing stream temperatures with shade being the single most important variable to reduce this heat input (*Gravelle and Link 2007, Krauskopf et.al. 2010*).

Watershed Function

Stream Channel Stability

Watershed flow changes/fluctuation can effect water quality through increased potential for damage to and destabilization of some stream channels and/or stream morphology.

When stream channel stability is impaired or the physical processes of a riparian area are not functioning properly, increased annual water yields and/or peak flows can result in an increased risk of in-channel erosion, degradation, and aggradation, which could reduce water quality and have detrimental impacts on beneficial uses.

Some stream channels are inherently resilient or susceptible to flow fluctuations (i.e., to the given existing stream channel/riparian conditions, geomorphological characteristics, stream morphology, riparian conditions and protection measures to be used [e.g., BMP]). Channels functioning properly have an increased ability to withstand fluctuations and potential changes in flows, and potential subsequent stream channel damage that could result in reduced water quality (sedimentation).

Grant and others (2008) generally concluded that when 15% of canopy is removed or harvested within a defined watershed, detectible changes (> 10%) in peak flows were made in rain-on-snow (ROS) dominated landscapes, and generally, peak flow changes may likely be undetectable if less than 15% of an area is clear-cut harvested within a defined watershed. A compilation of research on paired catchment studies for water yield increases showed that a canopy reduction of 20% or less will not show a measurable increase in annual water yield (*Stednick 1996, p. 90*).

Grant and others (2008) found that in ROS-dominated landscapes peak flow effects on channels, when they occur, are confined to reaches where the channel gradient is less than 2% and streambed and banks are composed of gravels and finer materials. An assessment of stream reach gradient, channel types and substrate provided and the results discussed in the Environment Consequences section (W-5).

Wetlands/Peatlands

Protection and maintenance of wetlands and peatlands are impotent considerations in maintaining overall health and function of watersheds.

Wetlands play a critical role in regulating the movement of water within watersheds as well as in the global water cycle (*Richardson 1994*). Wetlands, by definition, are characterized by water saturation in the root zone, at, or above the soil surface, for a certain amount of time during the year. This fluctuation of the water table (hydroperiod) above the soil surface is unique to each wetland type.

Wetlands store precipitation and surface water and then slowly release the water into associated surface water resources, ground water, and the atmosphere. Wetland types differ in this capacity based on a number of physical and biological characteristics, including: landscape position, soil saturation, the fiber content/degree of decomposition of the organic soils, vegetation density and type of vegetation (*Taylor et al. 1990*):

Wetland plants play an integral role in the ecology of the watershed. Wetland plants provide breeding and nursery sites, resting areas for migratory species, and refuge from predators (*Crance 1988*). Decomposed plant matter (detritus) released into the water is important food for many invertebrates and fish both in the wetland and in associated aquatic systems (*Crance 1988*). Physical and chemical characteristics such as climate, topography, geology, hydrology, and inputs of nutrients and sediments determine the rate of plant growth and reproduction (primary productivity) of wetlands (*Mitsch and Gosselink 1993 and Crance 1988).*

A wetland with more vegetation will intercept more runoff and be more capable of reducing runoff velocity and removing pollutants from the water than a wetland with less vegetation (*Demissie and Khan 1993; Richardson and McCarthy 1994*). Wetland plants also reduce erosion as their roots hold the streambank, shoreline, or coastline.

Peatlands support natural unique plant and animal communities and provide habitat for rare plant and animal species. Peatland waterflows, water quality, water chemistry, soil, organic substrate, and plant communities function under conditions characteristic of how they evolved. Upland areas surrounding peatlands that have the most direct influence on peatland characteristics, and stream segments that flow directly into peatlands, are managed to sustain the natural characteristics and diversity of those peatlands (2015 IPNF Forest Plan)

Methodology

The objective of this analysis is to disclose the potential effects of the project activities on watershed resources. Changes to sediment delivery, stream temperatures, and watershed function were used to evaluate potential effects on watershed resources.

The analysis begins with a description of the affected environment that characterizes the drainages within the project area and the aquatic resources found there. The affected environment section establishes a reference condition, providing insight into historical patterns and processes, natural ranges of variability and providing a basis for predicting the effects of natural and human disturbances. This section includes establishment of the existing condition where effects of past activities and natural events that have influenced the water resources can provide a baseline against which effects can be evaluated.

The environmental consequences section begins by examining the potential direct and indirect effects of proposed activities on watershed resources through analysis of changes in water quality and watershed function. This section includes an evaluation of potential cumulative effects. The cumulative effects analysis combines direct and indirect effects with effects of past, present, and reasonably foreseeable activities throughout the project area.

In order to assess the existing condition and effects to the water resources, background and supporting information for this report was gathered from field data, field reconnaissance and assessments, district files, road logs, geographic information system (GIS) data, historical records, historic and recent aerial photographs, published and unpublished scientific literature and Camp Robinson Project Resource Specialist Reports.

The existing condition section of this report establishes a reference condition context, provides insight into historical patterns and processes, and provides a basis for predicting/estimating the effects of natural and human changes.

The environmental consequences section examines the potential direct and indirect effects of the proposed activities. The cumulative effects analysis combine direct and indirect effects with effects of past, present, and reasonably foreseeable activities throughout the project area watersheds and/or streams.

Physical based models of ecological systems were also employed to help understand and estimate the effects of natural events and human activities, attempt to evaluate extremely complex interactions of environmental variables. A model's output is meaningful only when it is used to evaluate conditions in combination with local knowledge, field data, and professional judgment. Although a model can be used to generate quantitative values such as potential sedimentation, the results for this analysis are only estimates used to compare alternatives and provide estimates of possible environmental effects. The modeled results are not intended to predict the exact quantities of sedimentation that could be produced or routed to the stream network.

Information Sources

Literature and Office Review

Background and supporting information for this report was gathered from Forest Service fish and hydrology files, geographic information system (GIS) data, historical records, aerial photographs, road logs and published and unpublished scientific literature, local monitoring reports and CRP resource reports. Research for this project included information gathered from the Idaho Department of Environmental Quality. Also, a transportation analysis process (TAPS) was completed in 2018 that provided recommendations for long-term road management objectives within the project area.

FS WEPP – Forest Service Water Erosion Prediction Project

Several FS WEPP online interface tools were used as a means to predict and compare sediment delivery from physical disturbances such as wildfire, road construction and maintenance, timber harvesting, and prescribed burning. These models and supporting documentation can be found at: *http://forest.moscowfsl.wsu.edu/fswepp/*. The WEPP model is a physically based soil erosion model that provides estimates of soil erosion and sediment yield considering site-specific information about soil texture, climate, ground cover, and topographic settings *(Elliot et al. 2000)*.

FS WEPP:Road is a set of interfaces designed to allow users to quickly evaluate erosion and sediment delivery potential specifically from forest roads. The erosion rates and sediment delivery are predicted by the WEPP model, using input values for forest conditions developed by scientists at the Rocky Mountain Research Station *(Elliot et. al. 1999)*. FS WEPP:Road was used to estimate erosion and sediment yield from selected road segments within the project area. WEPP:Road values reflect road dimensions, design, topography, and proximity to water bodies among other parameters; output is in average annual amount of sediment delivered to streams.

Erosion research conducted in north Idaho by Spinelli et al. (2008) found favorable correlation to measured values using FS WEPP:Road. The accuracy of the predicted values from FS WEPP tools are, at best within plus or minus fifty percent. True erosion rates are highly variable due to large variations in local topography, climate, soil properties, and vegetative properties, so predicted values are only a single estimate of a highly variable process *(Elliot et al. 1999).*

Stream Channel Stability Assessment

To better understand cause and effects relationships (e.g., canopy removal and subsequent water yield/peak flow changes vs potential changes in water quality from morphological disturbances), the existing condition of stream channels in the project area, their inherent abilities/resiliency (i.e., to the given existing stream channel conditions, natural ranges of variability geomorphological characteristics, riparian conditions and protection measures to be used [e.g., BMP]) to withstand or not withstand fluctuations and potential changes in flows, and potential subsequent stream channel damage resulting in reduced water quality (sedimentation) was assessed and is discussed in detail. This discussion uses a combination of current literature reviews, Forest Service records, recent site-specific field information, recent stream channel function assessments and GIS data and historic watershed information.

Grant and others (2008) found that in ROS-dominated landscapes peak flow effects on channels, when they occur, are confined to reaches where the channel gradient is less than 2% and streambed and banks are composed of gravels and finer materials. An assessment of stream reach gradient (W-5), channel types and substrate (W-6) provided and the results discussed in the Environment Consequences section.

To further assess potential effects to streams channels and aquatic habitats resulting from modern forest management, using current techniques and practices, this report also includes recent monitoring results and reports. For example, the *2017 PACFISH/INFISH Biological Opinion (PIBO) monitoring report* which measures the overall effectiveness of BMP's and riparian buffers indicates that managed (i.e. logging, fuels treatments, road management, etc.) streams/watersheds within Moyie and Kootenai river basins are either improving or static in terms of water quality and and/or aquatic habitat (W-7) which points to the strong likelihood that BMP's and riparian buffers are effective in protecting and/or maintaining the local aquatic environments from anthropological caused effects.

BMP's include protection of RHCA's. "Riparian Habitat Conservation Areas RHCA's are portions of watersheds where riparian-dependent resources receive primary emphasis, and management activities are subject to specific standards and guidelines. Riparian Habitat Conservation Areas include traditional riparian corridors, wetlands, intermittent streams, and other areas that help maintain the integrity of aquatic ecosystems by, 1) Influencing the delivery of coarse sediment, organic matter, and woody debris to streams, 2) Providing root strength for channel stability, 3) Shading the stream, and 4) protecting water quality (Naiman et al. 1992)."

Past monitoring efforts (See Forest Plan monitoring reports) and current literature (Sweeny and Newbold 2014) show that the application of vegetative buffers around aquatic dependent ecosystems are effective at maintaining ecological processes for aquatic ecosystems.

Stream channels in the project area were surveyed and/or monitored and field reviewed during the 2017 and 2018 field seasons by the project hydrologist and fisheries biologist (W-8 and 9) to classify the health or state of physical processes of riparian-wetland areas. Several factors were the focus of functionality determinations, which included large woody debris abundance, adequacy of riparian vegetation (i.e., structure and composition), evidence of bank erosion and channel aggradation. Aerial photography interpretation of stream channels was used to investigate changes in canopy openings, riparian vegetation, stream channel migration or stability fluctuations over time, and to assess overall channel stability from a historic perspective and past cumulative effects from human and/or natural changes (W-8).

Stream classification, stability, dimensions, and substrate information was also collected using concepts from *Rosgen (1996)*. Stream type characterization using the Rosgen stream classification system provides a method for stratifying streams based on morphological characteristics such as channel gradient, sinuosity, width/depth ratio, dominant particle size of bed and bank materials, the entrenchment of channel, and the confinement of channel in the valley. Rosgen stream types are fully described in *Rosgen 1996* and summarized in (W-6).

Furthermore, professional judgment based on education and experience was also used to investigate and assess existing stream channel conditions, and potential effects to stream channels and water quality, associated with past and future management and/or natural wildfire events.

The Proper Functioning Condition (PFC) assessment involves using a standard checklist to consistently assess the hydrology, soils, and vegetation of riparian areas. The checklist and its summarization are used to classify the health or state of physical processes of riparian-wetland areas. Several factors were identified as limiting channel functionality, which included a lack of large woody debris, inadequate riparian vegetation (i.e., structure and composition), and excessive bank erosion and channel aggradation.

The PFC assessment method was chosen because it could provide a rapid method for assessing existing riparian and stream channel conditions, and trends in functionality, given input from multiple resource specialists. A more detailed explanation of the PFC assessment methods and example of the checklist can be found in project file W-8.

Methods to assess proper function condition (PFC) (*Pritchard 1998*) were used (W-10) to assess the condition and function of riparian areas and associated stream channels (i.e., sensitivity and/or resiliency) in the project area. The PFC assessment is a qualitative method for assessing the condition of riparian areas. A riparian area is considered to be in PFC when adequate vegetation, landform, or large woody debris is present to: Dissipate stream energy associated with high water flow; thereby reducing erosion and protecting or improving water quality, filter sediment, capture bedload, and aid floodplain development, improve flood-water retention and ground-water recharge and develop root masses that stabilize streambanks against cutting action. Furthermore a riparian area is considered to be in PFC when conditions develop diverse ponding and channel characteristics to provide the habitat and water depth, duration, and temperature necessary for fish production and other uses supporting greater biodiversity.

A summary of field survey techniques, rating system, and background information is found in project file W-10. Field survey results of these assessments are located in project file W-8 and W-9, and is summarized below. Project file W-8 and W-9 also shows, spatially, the stream reach rating results for the segments assessed within the watershed as well as the stream/field survey data and photos.

Water Yield and Peak Flow Discussion

The water yield and peak flow discussions and determination of potential effects to stream channels and water quality within the analysis area is based on a combination of literature reviews, local monitoring, field surveys/assessments (W-8), GIS information, historical vegetation management records (W-11), historical wildfire records/information (Fire and Fuels Report), natural range of variably assessment/discussion and the 2011 IPNF watershed characterization information (W-12).

Changes to water yields and/or peak flows does not automatically translate to decreased water quality or negative effects to stream channels or water quality. Despite the interest that peak flow and water yield changes from forest management has garnered, to date no field studies explicitly link peak flow increases with changes in channel morphology (*Grant 2008*). No known studies have demonstrated a direct correlation between peak flow changes attributed to forest harvest alone and changes to the physical structure of streams (*Grant 2008*). Ultimately, it is critical to understand stream channel responses and resiliency within the project area associated with past natural events such as large canopy openings. Large spikes in water yields/peak flows following past wildfires may have occurred due to canopy openings and decreased evapotranspiration (Fire and Fuels Report). Past wildfires (decreased evapotranspiration) and more recent wild fire suppression (increased evapotranspiration) have likely played an influential role in the existing condition of vegetation. Therefore, in terms of canopy openings and water yield/peak flow fluctuations, we consider anthropogenic and non-anthropogenic occurrences in the analysis area and natural ranges of variabilities. Despite the interest of peak flow and water yield changes from forest management has garnered, to date no field studies explicitly link peak flow increases with changes in channel morphology (Grant 2008). No studies known have demonstrated a direct correlation between peak flow changes attributed to forest harvest alone and changes to the physical structure of streams (*Grant 2008*).

Watershed processes are very complex and exist with large amounts of natural variability (*Elliot and Glaza 2007*). Possible connections between forest management and peak streamflows in the maritime regions of the Pacific Northwest have been intensively debated [*Jones and Grant*, 1996; *Thomas and Megahan*, 1998; *Beschta et al.*, 2000; *Jones and Grant*, 2001; *Thomas and Megahan*, 2001] because of concerns from the perspective of flooding hazards, stream morphology, water quality and fish habitat. The statistical analyses used in this debate are complicated by the many factors contributing to forest management effects on basin hydrology, including the chosen silvicultural system and logging method, the location within a catchment where timber harvesting takes place and road construction. Issues such as shortness of the streamflow records and climate variability are also of concern and not surprisingly mixed results have been obtained regarding possible impacts of logging on extreme events (i.e., 50 or 100 year flood). Snow accumulation and subsequent water yields are higher in open forest conditions, such as those created by timber harvest or fire (*McCaughey and Farnes 2001; Skidmore et al. 1994; Molnau and Dodd 1995*), and may result in peak flows from snowmelt occurring earlier in the spring (*Farnes 2000*). Most of the increase in water yield occurs during the spring runoff (*King 1989*). Climate largely determines the magnitude of large flood events (*Dunne and Leopold 1974*), but land use practices have been shown to increase peak flows (*Troendle and Kaufman 1987*). Effects of canopy removal on flows are scale-dependent with respect to basin area/size, hydrologic linkages and forest management practices/methods. Generally, removal of forest canopy through stand-consuming fires, forest insects and disease, or timber harvesting can increase water yield and modify hydrographs (i.e. increased peak flows). Many researchers have documented high variability in discerning relationships of the percent of a watershed harvested and changes in peak flows (*Thomas and Megahan 1998, Grant et al. 2008*). Therefore, a reduction in tree density and canopy cover results in decreased transpiration (uptake by vegetation of available water from precipitation) and canopy interception of rain and snowfall; thereby, increasing the amount of precipitation available for runoff. Over time, water yields trend to pre-harvest levels with vigorous shrub, eventual tree canopy regrowth, and subsequent increased evapotranspiration and interception of precipitation.

This analysis discusses and describes current conditions (given how much canopy was removed in the past (% area within a catchment) and how much time it has recovered) of defined watershed segments found in the project area with respect to prior forest cutting and recovery within these defined areas. No harvest amount, within a defined basin (% area within a catchment) threshold has been established within the IPNF forest plan. However, *Grant and others (2008)* generally concluded that when 15% of canopy is removed or harvested within a defined watershed, detectible changes (> 10%) in peak flows were made in rain-on-snow (ROS) dominated landscapes, and generally, peak flow changes may likely be undetectable if less than 15% of an area is clear-cut harvested within a defined watershed. A compilation of research on paired catchment studies for water yield increases showed that a canopy reduction of 20% or less will not show a measurable increase in annual water yield (Stednick 1996, p. 90). For the proposes of this assessment and water yield/peak flow discussions, past and proposed regeneration harvest type treatments are viewed effectively as canopy removal as it is more likely to produce a change in hydrologic conditions (flows) than thinning (*Lewis and Keppeler 2007 and Grant 2008)* or understory prescribed burning. Forest thinning may not cause any detectible peak flow changes in forested watersheds *(Grant 2008)*. In terms of water production (water yield/peak flows), conversion of vegetation and clearcutting are more drastic and effective treatments compared to partial or selective cutting (*Stednick and Troendle, 2016*). Therefore for the proposes of the water yield/peak flow discussions, past and proposed thinning type treatments are viewed as effectively negligible.

Also for the purposes of this analysis the range of 15% to 20%, based on current literature, of regeneration harvest will be used to qualitatively assess whether there may be a detectible change in peak flows given a defined area. Conservatively for this analysis the entire project area will be viewed as ROS landscape although ROS only continues approximately 80% of the area. No new system roads are proposed that could further open the canopy. Temporary roads would have very little impact to canopies because they would be placed on existing road prisms and/or they would be within an existing or proposed harvest area. All temporary roads would be obliterated and restored upon completion of the project. The larger the drainage area, the less likely detectible changes in flows can be measured (*Grant 2008*).

At the 6th level HUC scale (~17,000 to 25,000 acres in this area), harvest from the proposed action would show no measurable changes in flows because these watershed are very large relative to the harvest acres proposed. The 2011 IPNF watershed characterization information/spreadsheet indicate that all 6th level HUC's associated with the project area, other than Mission Creek, were rated having low equivalent clear-cut area (ECA) or in other words, open forest canopies from management. Mission Creek was rated as "moderate".

The Camp Robin proposed harvest is spread out and distributed across several 6th level HUCs which effectively decreases concentration of harvest in any one drainage. To better assess effects from the proposed vegetation treatments on flows, smaller catchments areas (within or closely connected hydrologically to the project area) (W-13) were assessed to show potential for localized and/or measurable changes. This is one of the main reasons the project area was selected as the spatial bounds for direct, indirect and cumulative effects analysis.

This analysis also provides a discussion regarding potential effects of historic, recent and planned harvest and/or canopy openings caused anthropologically and/or naturally on flow fluctuations. Aerial photography interpretation of the forested landscape and analysis of past and recent canopy openings in the project area is also used to qualitatively assess and discuss past water yield fluctuations, the potential for measurable water yield and or peak flow changes given the proposed action from a historic perspective and past cumulative effects from human and/or natural changes.

For example, a large spike in peak flows may have occurred due to large stand replacing wildfires that burned in the project area watersheds (W-35). For context, these type of peak flow spike will be considered as a water yield increase potential for the historic range of variation. Prior to these wildfires where most of the natural vegetative cover was undisturbed would be considered the lowest water yield potential. Water yields have likely been elevated to some extent and fluctuating following the early 1900's wildfires due to road building and timber harvest within the project area. Starting in the 1970's, water yields likely increased mainly from timber harvest activities within the project area. Over the past 40+ years, even with intermittent road building and timber harvest activities, peak flows likely fluctuated but trended towards and remained closer to 'natural' levels base on relative levels of vegetation removal and vegetation regrowth within the project areas. Today, canopies in the project area are more closed and dense then they were historically (Vegetation Report and Fire and Fuels Report).

Field Reviews

Streams within the project area were most recently surveyed during the 2017-2018 field seasons. Roads were surveyed and logged (W-14) to, in part, assess erosional hazards and risks to aquatic ecosystems. Reconnaissance of the project area roads included examination of stream crossings and drainage structures.

Stream reaches in Gillon, Meadow, Mission, Fry, Rock, Brush, Round Prairie Creeks and the Moyie River were reviewed by hydrology and fisheries specialists. The conditions of stream channels, riparian vegetation and hydrological processes for these reaches were assessed using a Proper Functioning Condition (PFC) survey.

Incomplete and Unavailable Information

All analysis and modeling is based upon best available data. At this point in time there is no known incomplete or unavailable information. If new information should become available, it would be stated and incorporated into the analysis.

Spatial and Temporal Context for Effects Analysis

Direct/Indirect and Cumulative Effects Boundaries

The CRP project area encompasses about 42,279 acres of which only about 14% has proposed vegetation treatments. Only about 50% of the proposed treatments would be regeneration type harvest (~7% out of the 42,279 project area). Direct, indirect and cumulative effects will be analyzed at the scale of the CRP area boundary which, with exception of the Meadow Creek watershed (100% within the project area), includes small portions (6%-28% of larger watershed areas) of 6 different 6th-code Hydrologic Unit Group subwatersheds (HUC-6; Table 2). There are numerous small drainages and narrow riparian zones within the project area that feed larger streams and creeks. Due to the dissected nature of the area watersheds/stream reaches and the fact that the proposed treatment areas are spread out across the dissected landscape, the primary area of focus for this analysis is on the activity areas and the distinct sub-watersheds or stream segments within the project area in order to properly analyze for potentially measurable effects and incorporate other disturbances that may have occurred or are currently occurring. Potential for measurable effects to water quality within project area streams or wetlands would likely be confined, due to the relatively small amount of localized treatments, to areas adjacent to or just downstream of disturbed areas. Analyzing at the 6th-code HUC's level would be too large to detect project related effects. Watershed areas and streams beyond the project area boundary have, in general, been heavily modified by the development of private agricultural lands over the past century. Therefore distinguishable effects from the proposed activities manifesting outside the project area boundary would likely be equivocal. The project area was also selected to be the cumulative effects area because no effects would occur within the Moyie River to the East and to the South or to the Kootenai River to the West. The vast majority of the proposed treatments are located in the headwaters of the 6 large 6^{th}-code HUC's and the activity areas are relatively small compared to the overall HUC sizes. Potential effects from the proposed activities to the watershed resources in the project area, if any, would likely be manifested indirectly, directly, and cumulatively in the perennial main stems and/or ephemeral streams of the project area. Further discussion regarding watersheds at the 6^{th}-code HUC's scale will occur only in order to present context regarding past disturbances and hydrologic connections/linkages.

Cumulative effects will be considered from the present year to approximately 2045, which would allow sufficient time for vegetation to recover in terms of hydrologic processes.

The temporal boundaries for analyzing the direct and indirect effects are approximately 5 years from present to allow all project related activities such as timber harvest, road work, and tree planting to occur. This timeframe was selected because the probability of erosion decreases several years after disturbance as vegetation recovers (*Elliot et al. 2004*). For the purposes of this analysis, long-term effects would generally be realized within, or potentially beyond, a 5- to 15-year period.

Affected Environment

The Camp Robin project area encompasses approximately 42,279 acres, with about 6191 acres or about14% of the project area which are actually proposed for vegetation treatment (includes 386 acres of prescribed burning only) in Boundary County, Idaho and is about 15 miles north of the city of Bonners Ferry (see EA). The project is separated into two portions (North and South) that are separated by Highway 95. Private inholdings are present within the portions of the project area.

Table 2. Watersheds within the Camp Robin Project area with Proposed Activities.

Watershed Name	Total 6th Code HUC watershed size (acres)	Defined portion/catchment area within project area boundary (acres)/% of total of the associated 6th level HUC
DL – KR	20174	4002/20%
BL – KR (Brush Lake)	25111	5455/21%
MC (Meadow Creek)	15598	15598/100%
MC (Mission Creek)	20029	2105/10%
RC– KR (Rock Creek)	18890	5431/28%
RMC (Gillon Creek/Round Prairie Creek)	23858	5519/23%
CC – MR (Moyie River)	18198	1241/6%

Topography and Climate

Elevations within the project area range from a low of 2100 feet at Brush Creek to about 5700 feet at the top of Tungsten Mountain. Most of the vegetation treatment areas are at elevations between 2500 feet and 4500 feet. Aspects are variable, Slopes range from about 4 to over 75 percent in the project area.
Records from the nearest weather station in Bonners Ferry, ID (located about 11 miles northwest of the project area) indicates January as the coldest month with average high temperature of 32.3°F and average low of 19°F. July is the warmest month with average high and low temperatures of 83.7°F and 50.1°F respectively. Average annual precipitation is 22.1 inches. The wettest month, on average is December with 3.09 inches and the driest month is August with 0.9 inches of precipitation. Average annual snowfall for Bonners Ferry is 65.4 inches with the most falling in December and January (Western Regional Climate Center 2017).

The climate data described above was collected using PRISM, a precipitation model within the US Forest Service WEPP models, which adjust precipitation and temperatures based on elevations and topography from established weather station data. The model allows users to input latitude and longitude and the model adjusts the climate for that location. A location near the center of the project was selected and input into PRISM which returned results of 4000 feet elevation with an annual average precipitation of approximately 43”. These estimates shows how elevation can influence precipitation within the project area. These climate values were used in the WEPP model to estimate erosion rates from the proposed treatment areas. More specifics on climate parameters generated by PRISM can be found in W-15.

Soils and Geology

A detailed discussion of geology and soils can be found in the soils report.

Across the project area there is a volcanic ash layer directly beneath this organic layer. This volcanic material accumulated from several Cascade volcano eruptions with most of the ash originating from Mt. Mazama (Crater Lake) in Oregon about 7,000 years ago. Volcanic ash has a high water holding capacity, low bulk density and is associated with high soil productivity. It is the expression of these properties that make it an ideal germination substrate for many native plants and home to an array of important micro and macro organisms. Volcanic ash is vulnerable to erosion by water and wind, especially when disturbed. When moist it is very sensitive to compaction and displacement. When retained on site, it contributes to that site’s biological resiliency (Soils Report).

Landscape morphology is primarily composed of dissected, moderately steep to steep glaciated mountain side slopes and low sloping ridges. There are numerous small drainages and narrow riparian zones within the project area that feed larger streams and creeks. Across the landscape, the soil has developed in a pattern consistent with the topographic relief, vegetation, and aspect. The soils have formed from in-situ weathering of existing geologic material; alluvial deposition and removal; and from volcanic ash fall (soils Report).

Wetlands

Wetlands/Peatlands

Several small wetlands were identified within the project area from searching the National Wetlands Inventory geospatial data (http://www.fws.gov/wetlands/) and field surveys. These and all other wetlands that may be located during layout and project implementation would receive appropriate protections as described in the project design features.

12 Special Treatment Areas (STA's), consisting of approximately 44 acres, have been identified in 3 units (units 39, 43 and 44). These areas were identified to restore Aspen stands in these units. Approximately 600 acres of the Camp Robin project area is dominated by deciduous hardwood vegetation including aspen. The dominant aspen cohort in these areas became established following the 1945 Brush Lake fire and is nearing maturity as it reaches 65 to 75 years old. Additionally, with lack of disturbance, the conifer components of these stands are increasingly competing with aspen for sunlight and nutrients, and aspen regeneration is generally sparse and leggy (Veg Report). Some of these stands area found within traditional wetland buffers, where encroaching conifers are threatening the Aspen clone. Within the STA's in units 39, 43 and 44, where a defined wetland exists, mechanical equipment will be permitted to reach into wetland RHCA buffers to harvest conifers; trees may be directionally hand-felled then retrieved by mechanical equipment. Mechanical equipment will not be allowed to drive into wetland RHCA buffers thus eliminating potential for ground disturbance. Removed conifers would be at least partially suspended to prevent damaging wetland soils. Additional conifers may be hand-felled and left onsite to further expose the aspen stand and provide barriers to ungulates and preventing over grazing.

Peatlands are types of wetlands that, due to longer saturation, develop peat-rich soils. Several peatlands in the project area are associated with lakes, such as Robinson, Dawson, and Brush Lakes. Round Prairie Meadow has peatlands located on private property adjacent to the project area. Other peatlands are found in exceptionally wet areas throughout the southern portion of the project area. The 2015 IPNF Forest Plan identifies a standard 660' buffer for peatlands, which will be utilized unless local topography or the existing road system provides sufficient surface drainage away from peatlands which would prevent vegetation management from impacting water quality and quantity in the peatland, in which case topography or the existing road would dictate the extent of the buffer.

Beneficial Uses and Water Quality Status

Water quality refers to the physical, chemical, and biological composition of a given water body and how these components affect beneficial uses. The Clean Water Act requires beneficial uses to be protected for each water body in the state. The designated beneficial uses for the project area creeks are cold water aquatic life, primary and/secondary contact recreation, and salmonid spawning. In addition to those listed above, industrial water supply, wildlife habitats and aesthetics are designated beneficial uses for all water bodies in Idaho.

A total maximum daily load (TMDL) for temperature in the project area creeks was approved by the EPA in 2014. The TMDL document identifies the streamside potential natural vegetation (PNV) that provides shade to the creek, and also identifies where shade may be lacking.

No streams in the project area are 303d listed for sediment concerns/impairment which indicates relatively good water quality in terms of healthy stream substrate in the area.

Stream Channel Characteristics

The project area contains approximately 88 miles of stream reaches, including portions of at least 16 perennial creeks in addition to more numerous intermittent and ephemeral drainages. Streams in the northern portion of the project area include Gillon Creek and its tributary Harvey Creek, which are tributaries to Round Prairie Creek, which itself is a tributary to the Moyie River. Streams in the southern portion of the project area include Meadow Creek, a tributary to the Moyie River, and Mission, Rock, Fry and Brush Creeks, which are eventual (well outside the project area) tributaries to the Kootenai River.

In forested ecosystems (such as the project area) woody debris plays a particularly important role in smaller 1st and 2nd order streams, which compose the majority of the stream in the project area, since it slows stream flows, dissipates energy, stores organic and sediment materials, and decreases potential for channelization and loss of fine material (*Jackson and Strum 2002*).

Most of the stream channel reaches within the project area contains copious amounts of LWD based on field reconnaissance (W-8 and 9).

Stream channels in the project area can be typically described as 'A' type channels, in the headwaters, which are steep (upwards of 25 percent), step-pool systems with gravel and cobble substrate with occasional boulders and frequent pieces of large woody debris (LWD). Finer material consisting of sands and small gravel were found in pools. "A" channels are characterized as entrenched, high energy debris transport systems which are resistant to disturbance when composed of boulder and cobble substrate (*Rosgen 1996*).

There is also a significant amount of 'B' channel type with large boulder substrate within the project area. Stream surveys on all the major perennial streams documented good habitat with pools, well vegetated stable stream banks and copious amounts of LWD throughout the project area streams.

Meadow Creek observed channel types progressed from a C4 near the end of the survey to B3/B4 and eventually to A3/A2 type near the headwaters. The 'A' type channels found are steep (upwards of 25%), step-pool systems with boulder and cobble substrate with bedrock intrusions. "A" channels are characterized as entrenched, high energy debris transport systems and are stable with boulder or bedrock substrate (*Rosgen 1996*). The 'B' Channel stretches have more moderate slopes (2-8%) with substrates ranging from cobble to sand in areas with large amounts of large woody debris. These channel types are sediment transport streams, with moderate entrenchment, limited floodplain development, low sinuosity and are very stable (*Rosgen 1996*). The permanent stream transect performed near the terminus of the survey identified the channel as a C4D type. "C" channels are low gradient, meandering, alluvial channels with well-defined floodplains (*Rosgen 1996*). The lower reaches of Meadow Creek have been re-routed and the riparian areas has had some grazing impacts leading to some channel incision where the creek flows through private land.

Municipal Watersheds

There two municipal watersheds within the project area that warrant discussion.

The Mission Creek municipal watershed: The Mission Creek Water system 9 (well) serves the Mount Hall Elementary School (public: Boundary County School District) and several homes in the area. The school is located 16 miles north of Bonners Ferry, 10 miles south of the Canadian border, and has an enrollment of approximately 175 students and 30 faculty and staff. See W-16 for more detail on the location of the well and the location of the school in relation to Highway 1, Mission Creek, and the Kootenai River. The Proposed activities are located above water system is minimal and would protected by forested stream buffering and therefore would not be impacted (W-17).

The Bee Line Water Intake on Meadow Creek: The Meadow Creek headwaters are the only source of surface drinking water for more than 100 households in the Beeline Water Association. The Proposed activities are located well below this intake and therefore would not be impacted (W-16).

Existing Condition

Water Quality

Sediment Delivery

Road densities can provide a relative measure of road-stream interaction and the relative risk for increased flows and sediment input into the hydrologic system. This is especially true for road density within the riparian habitat conservation areas as well as highly sensitive landscapes. Areas with higher road densities within riparian habitat conservation areas are at greater risk for flow modification and sediment loading. A review of research in Idaho and elsewhere concluded that non-channelized runoff from roads has a low probability of traveling further than 300 feet (*Belt. et al. 1992*). Riparian road densities were calculated by dividing the total road miles of open road within 300 ft. of streams by within the project area by the project area square mileage. Roads located of highly sensitive landscapes ("High Mass Failure Potential") in the project area is limited due to the local geology (Soils Report) and minimal sensitive landscapes (W-24).

Table 3. Road miles and road densities within project analysis units (W-34)

6th level HUC Watershed Name	Approximate Road Miles in Project Area by drainage	Project Area Riparian Road Density (mi/mi²)
Mission Creek	14	4.1
Round Meadows Creek	27	3.1
Copper Creek – Moyie River	8	3.9
Meadow Creek	75	3.1
Dawson Lake-Kootenai River	33	5.2
Rock Creek – Kootenai River	26	3.0
Brush Lake – Kootenai River	17	1.9
Fleming Creek	8	1.8

The majority of the sediment within the project area currently being delivered to creeks comes from roads open to public motorized use. This is expected as these roads see high motor vehicle use, have limited maintenance, and often times located in very close proximity to valley bottom creeks. The restricted motorized use roads have less wear and damage from traffic (i.e. rutting in the wheel tracks) and have a greater vegetative cover across the driving surface which reduces erosion.

Water Temperature

The vegetation within the RHCAs found in the project area is primarily intact, providing the protective shade to the waterbodies. There are areas that have had timber harvest in the past and are recovering and have not fully reached their maximum shade providing potential. There are also areas where roads encroach on the RHCAs and have reduced shade for the width of the road. The 2014 Potential Natural Vegetation (PNV) Temperature TMDL (IDEQ 2014) for project area streams indicates where more shade is needed to reach reference conditions for the expected amount of riparian vegetation (W-18).

Watershed Function

Stream Channel Condition and Stability

Field surveys and monitoring conducted in the area (W-8 and W-9), along with analysis of elevations and slopes using GIS and aerial photography analysis, indicate that most stream channels in the project area are of the type that have low likelihood of damage from water yield/peak flow fluctuations; due to channel type, geomorphological and stable physical properties of higher stream gradients with cobble to boulder substrates and the existence of abundant instream woody debris. Refer to the field review summaries below for further discussion of the exiting condition of the project area stream channels.

Stream systems normally function within natural ranges of temperature, sediment, flow, and other characteristics in dynamic equilibrium. When the system is pushed beyond these normal ranges, it may require intervention or protection to help restore or move toward "dynamic equilibrium". When a stream is functioning it has a greater ability to facilitate natural climactic or environmental fluctuations without unnatural channel degradation. Based on gathered stream channel information, as well other available watershed information, stream channels were qualitatively assessed in terms of their current trend (i.e., toward or away from functioning properly).

Given the elevations (conducive to ROS events), past management, existing roads, and past large wildfires in the project area, peak flow changes/fluctuation have likely occurred; however, it appears, that most stream channels or reaches throughout the project area are functioning properly and have either not been effected or recovered from past natural and/or human caused effects such as any peak flow fluctuations from canopy openings, and are generally vertically and horizontally stable (W-8 and table 4).

In forested ecosystems woody debris plays a particularly important role in smaller 1st and 2nd order streams (which is the majority of the stream in the project area), since it slows stream flows, dissipates energy, stores organic and sediment materials, and decreases potential for channelization and loss of fine material (*Jackson and Strum 2002*).

Most stream reaches that flow out of the project area flow through private lands, which have been developed for agricultural purposes, outside the project area but most of these 1st and 2nd order (smaller tributary streams) channels flowing through private lands maintain vegetated riparian buffers which likely maintains channel integrity and function.

Methods to assess proper function condition (PFC) (*Pritchard 1998*) were used (W-10) to assess the condition and function of riparian areas and associated stream channels (i.e., sensitivity and/or resiliency) in the project area. The PFC assessment is a qualitative method for assessing the condition of riparian areas. Results as discussed further in detail below.

Water Yield and Peak Flows

On average streamflow begins to increase in April as the snow pack melts, with peak flow usually reached in May. Not all snowmelt or rainfall immediately becomes surface runoff. The majority of the precipitation infiltrates the soil surface to become groundwater that percolates downward into the subsoil and bedrock and resurfaces in wet areas, seeps, spring, and perennial streams at various elevations below the point of infiltration. Slow release of groundwater provides stream base-flow beginning in mid-July and continues until the fall rains, which typically begins in mid-September.

Within the project area forest canopies were more naturally open historically than they are today given wildfire exclusion and overstocking (Fire and Fuels report) indicating that past water yields and peak flow were not based on a 100% closed canopy system. Changes to forest watershed hydrology (i.e., water yields and/or peak flows) may in theory cause diminished water quality to some stream channels because stream banks can become destabilized, increasing erosion and deposition potential.

Past vegetative treatments, road construction, wildfire, and past fire suppression have likely had some effect on the analysis area hydrology directly, indirectly, and/or cumulatively through changes of the hydrologic cycle. Change in canopy cover or density may effect transpiration, interception, snow accumulation, evaporation from the ground surface (e.g., wind velocity and radiation balance changes), sublimation, and organic material accumulation.

Fire played a central pre-settlement role in shaping the composition, structure, distribution, arrangement and function of vegetation within the Camp Robin project area. Fire suppression has had profound effects on the function of these systems and their biodiversity. Stand densities increased and fire-tolerant species have been widely replaced by fire-intolerant species such as grand fir, white fir, and small diameter Douglas-fir. This influx of shade tolerant understory species has altered stand structures as single-layer canopies have progressed towards dense, fire ladder laden, multiple-layer canopies which has had effects on expected fire behavior, as discussed in the Camp Robin (Fire and Fuels report). These shade tolerant, fire intolerant species tend to be more susceptible to insects and pathogens (Vegetation Report).

The largest lethal or stand-replacing fire in the project area burned in the 1890's and consumed about 16,000 acres, primarily in the northern portion of the project area. In 1945, the Brush Lake fire burned across about 4,500 acres of the southern portion of the project area in the vicinity of Brush Lake (W-35).

Since European settlement in the area at the end of the 19th century, the landscape in the project area has undergone substantial changes. In addition to the implementation of an aggressive fire suppression policy, logging in the first two thirds of the 20th century also had notable effects on the composition and structure of forest vegetation in the project area. This logging focused on easily accessible stands containing large trees Vegetation Report Report).

Large stand replacing wildfires that burned in the project area watersheds in the past (i.e., early 1900s and late 1800s [PF: RRFF]) may have naturally caused relatively large sediment pulses from erosion, caused by, large areas of hydrophobic soils, loss of riparian vegetation and riparian LWD coupled with water yield and peak flow fluctuations due to reduced evapotranspiration. These past sediment pulses may have been much greater than any other natural or unnatural causes of sedimentation or flow fluctuations that have occurred in this watershed since there occurrences. This level of naturally caused increase in water yields, due to canopy reduction and subsequent reduction in evapotranspiration, would be considered within the historic natural range of variability for this analysis and watershed, and as a natural process.

Regulated timber harvest on Federal lands in project area began in the early 1970s and continued into the late 1990's. During this period, road systems were developed and even-aged silvicultural systems were used to create forest openings and regenerate early seral species in the absence of stand-replacing fire. However, these openings were generally limited to less than 40 acres due to requirements in the National Forest Management Act that place limitations on the size of openings created through even-aged timber harvest. Given this limitation, and the lack of recent stand-replacing fire, it is not surprising that the combination of small and medium size class forest comprises a large portion of the landscape and that the extent and size of patches of early seral forest vegetation is near the lower end of the historical range of variability at the Kootenai Subbasin scale (Vegetation Report).

More recent management efforts to pursue restoration and fuels reduction goals have had generally positive effects on forest composition, structure and pattern in the project area.

Past large openings can take up to 40 to 60 years to fully return to their original condition (assuming 100% canopy cover) of local hydrological processes. Most of the past timber harvest (which was a mix of regeneration and thinning type) occurred in the project area before 2000 (W-11 and 12) and almost all occurred before 2010. Intermediate harvest type left canopies with good retention. These past harvested areas are likely not contributing appreciable sediment from erosion or runoff to streams at a site scale, or at the watershed scale, given protective vegetative stream buffers, natural vegetative recovery, site productivity reforestation, increased ground cover and a reduction in overall watershed roads and adjacent riparian roads. Most of the recent (past ~ 25 years) past harvest was intermediate which retained canopy cover and soil moderation function and has likely recovered in terms of increased canopy cover and increased evapotranspiration. Within the project the vast majority of stands that received treatment (pre 1992) have likely vegetative recovered (based on aerial photography analysis and field reviews) to the point they are likely hydrologically stabilized on the landscape to near pre harvest conditions (W-12), given the exclusion of wildfire, which would result in increased evapotranspiration and interception of precipitation which reduces the potential for increased erosion and changes to water yields/peak flows. Previously harvested areas are likely not contributing any appreciable erosion or sediment to project area streams channels (W-8) and are well on their way to hydrologically recovering from the past vegetation treatments; due to vigorous second growth consisting of either large to medium sized trees, poles, shrubs, grasses, and other ground cover. Most of the previously harvested areas completed in the early 1990s and early 2000s are likely hydrologically stable (i.e., increased evapotranspiration rates and decreased runoff potential) and relatively well vegetated due to productive site conditions for vegetation growth (i.e., habitat types) that exist in the project area.

Rain-on-snow Events and Watershed Responses

Changes to forest watershed hydrology (i.e., water yields and/or peak flows) can cause diminished water quality, in rain-on-snow (ROS) dominated landscapes, to some stream channels because of increasing erosion and deposition potential.

Given the elevations (conducive to ROS events), past management, existing roads, and large wildfires in the project area, peak flow changes/fluctuation have likely occurred; however, it appears, that most stream channels or reaches throughout the watershed are functioning properly and have either not been effected, recovered, and/or are recovering from past natural and/or human caused effects such peak flow fluctuations, and are generally vertically and horizontally stable (W-8).

Runoff from rain falling on snow has been associated with increased risk of damage to stream banks and flooding. Available data indicates that rain falling on snow in open areas produces more water available for runoff than rain falling in forested areas. Much of the project area (~80%) falls in the rain-on-snow zone based on elevation (between 3500’ and 4500’).

Effects from peak flow events caused by rain-on-snow events are generally confined to Low gradient stream reaches (< 2%), which are composed of gravels and finer material (i.e., overall more erodible), according to *Grant 2008*. Higher peak flows can be caused by rain on snow (ROS) events. Field and stream surveys and monitoring conducted in the area (PF), along with analysis of elevations and slopes using GIS and aerial photography analysis, indicate that most channels in the project area are of the type that have low probability of damage from higher peak flows or ROS events; due to channel type, forested buffers and physical properties of stream gradient. Refer to the field review summaries below for further discussion of the existing condition of the project area stream channels.

Peak flow changes/fluctuations have always occurred given that the project area is subject to ROS events, has had past vegetation management, road building, and has experienced large wildfires. All of which have occurred at different timeframes but have likely not created conditions beyond the natural rage of variability given variable forest canopy openings over time.

Stream channel assessments results suggest that, with a few exceptions, most stream channels or reaches throughout the watershed are functioning properly likely due to the inherently stable channel type, stabilizing inputs of large woody debris, and the heavily vegetated riparian areas held together by supporting root masses (W-8).

Existing conditions of stream channels from peak flow or water yield changes may reflect how watersheds with similar conditions and landtypes have responded over time to a similar history of disturbance. Stream channel assessments help to provide an indicator of watershed condition and trend. Stream channels can be modified because of both human-caused and natural events.

Stream channel responses to past flood or high-flow events, including ROS events that occurred, coupled with watershed activities such as logging and road building in the project area can provide qualitative insight to the sensitivity, resiliency, or stability of the stream channels, and the relative ability of the streams to accommodate flow fluctuations.

Through field reviews within the project area, stream channels and their morphologies were surveyed and/or monitored to investigate and document exiting conditions and qualitative effects associated with past management, as well as past wildfires, that may have theoretically changed peak flows and water yields by changing hydrologic processes; therefore, potentially affecting stream channel stability, channel erosion, and sedimentation within the project area streams (W-8).

Properly Functioning Condition (PFC) Stream Channel Condition, Characterization, and Stability Assessments

Introduction

Approximately 88 miles of stream reaches, including portions of at least 16 perennial creeks in addition to more numerous intermittent and ephemeral drainages are found in the project area. The larger streams in the project area, consisting of multiple reaches within the 6 separate watersheds containing or adjacent to proposed activities, were assessed using the PFC survey concepts (W-10) to determine the existing conditions, characteristics and function of streams and riparian areas.

Existing function and condition of stream channels, as well as their ability to facilitate flow fluctuations, high flows events and watershed processes, within the major streams of Meadow Creek, Mission Creek, Fry Creek, Rock Creek, Brush Creek, Round Prairie Creek, Gillon Creek and a Moyie river Stream Reach, is based on the PFC assessment (PFCA) conducted in 2017 and 2018 (W-8), and summarized by stream and reach below (table 4). The U.S. Forest Service (Hydrologist and Fisheries Biologist) conducted the assessment to better understand existing watershed conditions including potential cumulative effects to stream channel function from increased water yields and peak flows, managed and unmanaged roads, and past wildfires.

These main stem streams were delineated into distinct reaches to assess their Proper Functioning Condition (PFC), based on channel type and or significant morphological or topographic changes, natural breaks, and perceived riparian condition.

Table 4: Summarized Stream Channel PFC Rating by Stream and Reach

Stream Segment	Reach Length (feet)	PFC Rating	Trend	Stream Segment
Meadow Creek Reach 1	~11,700	PFC	Maintained	Where there is floodplain abundant vegetation (multiple age classes for LWD maintenance and recruitment), stable soils and/or land form characteristics existing and inherent stable stream channel type. Channel in confined in areas due to valley form. Vertically and horizontally stable. Stable bedrock controls throughout the system.
Meadow Creek Reach 2	~11,000	FAR	No Trend	This reach on private may be more sensitive to aggradation and channel instability given that it is a lower gradient transition zone for alluvium settling as gradients become slightly more gradual. Furthermore grazing and channel modification has occurs in the past. Low to moderate levels of riparian vegetation, for stability and recruitment, and in-stream LWD exists in this reach. No apparent trend was noted because the stream channel appears to maintain stability given deep rooted stream bank grasses and rotted riparian broad leaf species. Steam bank do not appear to have recent excessive bank erosion occurrences. Vertically and horizontally stable at this time.
Meadow Creek Reach 3	~8,150	PFC	Maintained	Abundant floodplain vegetation (multiple age classes for LWD maintenance and recruitment) on 90% of reach, stable soils and/or land form characteristics existing and inherent stable stream channel type. Abundant and stable instream LWD. Minimal channel bed movement. Vegetated point bars indicate stable hydrologic process.
Meadow Creek Reach 4	~11,400	PFC	Maintained	Abundant floodplain vegetation (multiple age classes for LWD maintenance and recruitment) on 100% of reach, stable soils and/or land form characteristics existing and inherent stable stream channel type. Abundant and stable instream LWD. Minimal channel bed movement. Vertically and horizontally stable at this time. Vegetated point bars and substrate indicate stable hydrologic process.
Meadow Creek Reach 5	~7,000	PFC	Maintained	Abundant floodplain vegetation (multiple age classes for LWD maintenance and recruitment) on 100% of reach, stable soils and/or land form characteristics existing and inherent stable stream channel type. Abundant and stable instream LWD. Minimal channel bed movement. Vertically and horizontally stable. Vegetated point bars and substrate indicate stable hydrologic process. No evulsions or aggradation of bedload from the East Fork of Mission Creek were observed at the confluence.
Meadow Creek Reach 6	~13,150	PFC	Maintained	Abundant floodplain vegetation (multiple age classes for LWD maintenance and recruitment) on 100% of reach, stable soils and/or land form characteristics existing and inherent stable stream channel type. Abundant and stable instream LWD. Minimal channel bed movement. Vertically and horizontally stable. Vegetated point bars and substrate indicate stable hydrologic process.
Mission Creek Reach 1	~5750	PFC	Maintained	Reach begins on east side of bridge crossing at highway 1. Abundant stream bank vegetation (multiple age classes for LWD maintenance and recruitment) on 100% of reach, stable soils and/or land form characteristics existing and inherent stable stream channel type. Stream gradients (>5%) and substrate inherently stable and resilient. Abundant and stable instream LWD. Minimal channel bed movement. Vertically and horizontally stable. Stable bedrock/boulder controls throughout this reach.
Mission Creek Reach 2	~9700	PFC	Maintained	Reach begins at the forest service boundary. Abundant deep rooted stream bank and flood plain vegetation (multiple age classes for LWD maintenance and recruitment) on 100% of reach, stable soils and/or land form characteristics existing and inherent stable stream channel type. Stream gradients (>5%) and substrate inherently stable and resilient. Abundant and stable instream LWD. Minimal channel bedload movement. Vertically and horizontally stable. Stable bedrock/boulder controls throughout this reach.
Brush Creek Reach 1	~6800	PFC	Maintained	Reach starts on the east side of highway 95. Abundant floodplain/stream bank vegetation (multiple age classes for LWD maintenance and recruitment), stable soils and/or land form characteristics existing and inherent stable stream channel type. Stream gradients (>5%-10%) and substrate inherently stable and resilient. Vertically and horizontally stable. Lake system above this reach affords moderated flows and headwater inputs. Reach ends at Brush Lake.
Brush Creek Reach 2	~9230	PFC	Maintained	Reach starts on the east side of Brush Lake. Abundant floodplain/stream bank vegetation (multiple age classes for LWD maintenance and recruitment), stable soils and/or land form characteristics existing and inherent stable stream channel type. Stream gradients (>5%-10%) and substrate inherently stable and resilient. Abundant and stable instream LWD. Minimal channel bedload movement. Vertically and horizontally stable.

Stream Segment	Reach Length (feet)	PFC Rating	Trend	Stream Segment
Rock Creek Reach 1	~11,000	PFC	Maintained	Reach starts on the east side of highway 95 where Rock Flows through a culvert at the highway. Abundant stream bank vegetation (multiple age classes for LWD maintenance and recruitment), stable soils and/or land form characteristics existing and inherent stable stream channel type. Stream gradients (>5%-15%) and substrate inherently stable and resilient. Geomorphically incised channel. Abundant and stable instream LWD. Minimal channel bedload (mostly small boulders) movement. Vertically and horizontally stable.
Rock Creek Reach 2	16,550	PFC	Maintained	Reach starts at FSR 2496. Abundant stream bank vegetation (multiple age classes for LWD maintenance and recruitment), stable soils and/or land form characteristics existing and inherent stable stream channel type. Stream gradients (>5%-13%) and substrate inherently stable and resilient. Abundant and stable instream LWD. Minimal channel bedload (mostly cobble and gravels) movement. Vertically and horizontally stable. Abundant and stable instream LWD. Reach ends at the FSR Camp 9.
Fry Creek Reach 1	~6700	PFC	Maintained	Reach starts on the east side of the Meadow Creek Road. Abundant floodplain/ and deep rooted stream bank vegetation (multiple age classes for LWD maintenance and recruitment), stable soils and/or land form characteristics existing and inherent stable stream channel type. Stream gradients (>3%) and substrate inherently stable and resilient. Lake system above this reach affords moderated flows and headwater inputs. Low stream power/flow fluctuation capability. Reach ends at Dawson Lake.
Round Prairie Creek Reach 1	~12400	PFC	Maintained	Reach starts at the confluence with little Hellroaring Creek and heads west. Abundant floodplain/ and deep rooted stream bank vegetation (multiple age classes for LWD maintenance and recruitment). However mostly broad leaf species due to wet and frequently inundated floodplain. Stream gradients (<3%). Lower gradient channel is currently stable and resilient. A Complex series of wetlands and ponds and geomorphic features greatly moderates downstream flows. System appears to be stable and non-degraded. Above and throughout this reach affords moderated flows and headwater inputs. Low stream power/flow fluctuation capability. Reach ends at Robinson Lake. Evidence of some past riparian modification however vigorous deep rooted bank and flood vegetation protects and makes for a resilient aquatic environment.
Gillon Creek Reach 1	~14900	PFC	Maintained	Reach starts on the West side of Robison Lake. Abundant floodplain/stream bank vegetation (multiple age classes for LWD maintenance and recruitment), stable soils and/or land form characteristics existing and inherent stable stream channel type. Stream gradients (>5%-10%) and substrate inherently stable and resilient. Abundant and stable instream LWD. Minimal channel bedload movement. Vertically and horizontally stable. Reach ends in a stable mountain meadow system that moderates catchment flows and headwater inputs.
Moyie River Reach 1	~10250			Reach starts at the confluence with Copper Creek. Abundant floodplain/stream bank vegetation (multiple age classes for LWD maintenance and recruitment), stable soils and/or land form characteristics existing and inherent stable stream channel type. Stream gradients (~3%) and substrate inherently stable and resilient. Large broad valley river system. Relatively Vertically and horizontally stable given its scale. Reach ends at the highway 95 bridge that crosses the Moyie River about a mile south of the Canadian Border.

*See W-8 for detailed channel condition report and channel type information

PFC = properly functioning condition; FAR = functioning at risk

Environmental Consequences

Summary of Environmental Consequences

Overall, the major perennially flowing stream channels, aquatic habitats and watersheds within analysis area would continue to function properly, be maintained or somewhat improved. Reach 2 in Meadow Creek which is rated as "Functionally at Risk" (FAR) (W-8) would with a static trend would continue to function as such due to the limited amount of proposed road and vegetation treatments within the Meadow Creek drainage and near the stream. Field surveys and field monitoring, along with aerial photography analysis, indicate that streams and reaches within the project area are generally hydrologically stable, well vegetated, contain abundant woody debris for recruitment and maintenance, and have shown resiliency and stability over time (W-8 and 9). Currently most stream channels are able to function naturally within their flood plains and hydrologic networks (W-8).

IDEQ (*Idaho DEQ 2017*) determined that to comply with state water quality standards and the developed temperature TMDL's the project area streams require maintenance and protection of stream shade canopy to meet the intent on the Clean Water Act (W-1). Table 5 below illustrates the predicted trends to resource indicators given Alterative 1.

Table 5. Trends to Resource Indicators Given Alternative 1

Resource Indicator	Trend
Water Quality (Sediment Delivery Potential)	Trend long-term in sedimentation would likely remain static with some continued risk of sedimentation at road/stream crossings. Most existing road segments in the project area pose little threat to water quality given their condition and locations away from streams and higher on the landscape near ridges. Minimal landscapes are found in the project area containing "high mass failure potential" (Soils Report). Existing vegetated stream buffers would continue to act a buffer/filter from sediment entering water courses.
Water Quality (Stream Temperatures)	Cover and shade in riparian areas would remain, but this may change with time as root disease and insect infestations progress and infect older trees and trees and brush grows in riparian areas. Changes would not occur quickly or all at the same time, so canopy cover would remain in riparian areas providing shade and maintaining stream temperatures. Large-scale canopy opening events (stand replacing type) such as wildfire and subsequent reduced cover could increase stream temperatures within project area due to the loss of shade.
Watershed Function (Stream Channel and Wetland/Peatland Stability)	Stream channel stability throughout watershed would generally be maintained in a functioning and/or unchanged condition. Riparian grazing would be a limiting factor in trending toward improvement on the lower main stem of Meadow Creek. Large-scale canopy opening events (stand replacing type) such as wildfire and subsequent reduced cover could increase the potential for decreased water quality and erosion due to peak flow fluctuations and sedimentation from destabilized stream channels through a loss of riparian vegetation.

Alternative 1 – No Action

Under this alternative, certain management activities would not occur in the project area as described above (stand improvement/timber harvest, prescribed burning/fuels reduction, road improvement, obliteration of old road prisms, road storing (includes culvert removal) and wildlife habitat improvements. Other management activities would still likely occur (minor road maintenance, and control of roadside invasive plant species), but maybe not to the degree proposed in the action alternatives. The condition of the project area water resources and project area streams would likely follow existing trends and remain relatively unchanged while relying on natural processes to maintain or restore some impacts associated with past management activities mostly related to existing roads. Deteriorating road conditions and associated chronic sedimentation would likely increase without the needed level of road maintenance and this would likely present a moderate risk of reducing water quality and altering beneficial aquatic habitat.

Direct and Indirect Effects to Water Quality

Sediment Delivery

Because no activities are proposed under this alternative, no new management induced direct and indirect impacts from sedimentation would occur in the Camp Robin project area.

Sediment contributions from roads would remain unchanged from the existing condition. Road maintenance would likely occur as normal and would be mostly beneficial following BMPs, but the normal intensity of maintenance may not provide the same degree of improvements as proposed with reconstruction, to reduce the risk of road failures. Therefore, the lack of road improvements commensurate with the current level of road conditions in the project area could perpetuate sediment delivery from surface erosion and increasing risk of culvert failures.

Alternative 1 would not remove up to 35 culverts or upgrade up to 10 culverts within the project area and would not store, decommission or obliterate project area roads thus forgoing long-term sediment reducing/water quality improvement activities with this project.

The existing tend and increased risk for undesirable fire behavior would not be reduced (see Camp Robin project *Fuels and Fire* report) and therefore could potentially lead to a higher risk of damage to the water resources within the project area. Fire is a frequent natural disturbance that has both immediate and long-term consequences for stream ecosystems because it can affect water temperature (*Minshall et al. 1997*), nutrient dynamics (*Spencer et al. 2003*), channel morphology (*Dunham et al. 2007*), stream biota (*Minshall 2003; Pilliod et al. 2003; Burton 2005*), and habitat complexity and structure (*Meyer and Pierce 2003; Wondzell and King 2003*).

Alterations to forest composition, structure and pattern in the Camp Robin project area have acted to greatly diminish the resistance and resilience of the existing forest vegetation to disturbance agents including insects, diseases and fire relative to “historic” conditions. This is readily apparent throughout the project area, both in recent insect and disease-caused mortality and in the high hazard of future mortality (Vegetation Report).

Delaying harvest in overstocked timber stands could result in an increase in tree mortality and fuel build-up. Continued fuel loading would increase the risk of high intensity wildfires that could kill most of the vegetation in both upland and riparian areas. *Spigel and Robichaud (2007)* reported maximum erosion rates exceeding 32 tons/acre after high intensity fire on steep slopes in west-central Montana, depending on fire intensity, terrain, and climate. Increased runoff combined with a lack of vegetative cover to protect soils following a fire would lead to increased peak stream flows, excessive sediment delivery and consequent adverse impacts to water quality and aquatic habitat. The risk of debris flows immediately after a fire increases as a result of soil impacts coupled with increased potential for surface runoff. Debris flows can be the most damaging in the short-term to stream networks by the quantity of sediment that can be delivered. Impacts to soil erosion from these disturbances typically last a few years before rapid revegetation covers the surface with protective plant litter (*Elliot 2004, Ryan and Dwire 2012*).

Roads and Riparian Road Densities

Project area road densities would remain unchanged because no temporary roads would be constructed and no roads would be stored or decommissioned.

Water Temperature

With Alternative 1, there would likely be no immediate change in vegetation within the RHCA buffers. Root disease is affecting trees in riparian areas, so larger trees may slowly decline. As regeneration develops it would become infected with root disease, and may not reach maturity, but it would provide shade. These changes would not occur quickly or all at the same time, and brush would continue to grow, so canopy cover should remain in riparian areas; maintaining shade and stream temperatures. In the event of a large, stand-replacing wildfire that burns riparian areas, stream temperatures would likely rise temporarily due to a loss of shade.

Direct and Indirect Effects to Watershed Function

Stream Channel Stability

Overall, analysis area stream channels were found to be stable, resilient, and well vegetated maintaining good amounts of LWD and other stabilizing structures, such as boulders and larger angled rock supported by vertical bed rock controls. Furthermore the project area stream channels appear to have maintain stability and resiliency over time given the well vegetated stream banks, abundant in channel LWD structure that has evidently remained intact and in place within the channel overtime. Point bars and substrate appear to have had little movement or disturbance over time given the abundant substrate mosses and other riparian plant growth in these areas. Because of the project area streams stable conditions and inherent resiliency to flow fluctuations, stream channel conditions would likely remain unaffected by water yield/peak fluctuations that are currently occurring and that may occur due to the proposed vegetation treatments given the exclusion of stand replacing wildfire.

As described above, given all the stream and water data and information collected in the analysis area watersheds (i.e., Meadow, Brush, Mission, Rock, Gillon, Fry, Round Prairie Creeks and the Moyie River) no definitive evidence (e.g., erosion, channel degradation, head-cutting) exists that notable changes in peak flows have actually occurred, or have had a major direct or indirect effect on stream channels and water quality, as a result of harvest activities within the watershed over the past several decades (W-8). The existing condition (e.g., flows) would likely remain similar to recent years given similar precipitation, and provided no events such as large wildfires occur in the area in the future.

The condition of forest vegetation in unmanaged portions of the project area does not currently meet desired conditions which would contribute to a build-up of ladder fuels and surface fuels (vegitaion Report and Fire and Fuels Report).

As these species increase as a percent of stand composition, the risk of losing entire stands, including riparian areas, to wildfire increases greatly. This progression would result in the continued build-up of ladder fuels and surface fuels, increasing the risk of an uncontrollable fire, potentially stand replacing, with severe effects.

If large stand replacing wildfires were to occur they may increase water yields and peak flows, due to extensive canopy openings and reduced evapotranspiration, that could lead to stream channel erosion and reduced water quality if loss of riparian LWD and other woody structure was to occur simultaneously.

Literature reviews as discussed above indicate that the occurrence of large wildfires could cause effects (greater potential with this alternative) that could result in increased water yields and peak flows due to large canopy openings, loss of riparian vegetation or buffers, and reduced evapotranspiration that could lead to channel erosion and reduced water quality.

In the absence of large stand replacement type wildfires, stream channels within the watershed should continue to be maintained (see Existing Conditions Section) and should continue to function properly.

Wetland and Peatlands

Some wetlands in the project area, especially the ones found within STA's in units 39, 43 and 44 would continue to loose there Aspen component due to the continued intrusion of conifer species. This intrusion may also lead to a change in the annual water availability and storage capabilities within the wetlands which may affect other riparian plant species. More detailed information regarding wetlands within the project area and with STA's can be found in the (Botany, Vegetation and Wildlife Reports).

Peatlands would likely remain unaffected given Alterative 1, however if large stand replacing wildfires were to occur there may be an increase in water yields and peak flows, due to extensive canopy openings and reduced evapotranspiration, that could lead to erosion and sedimentation to peatlands which could reduce their size and function.

Alternative 2 (Proposed Action)

A full description of Alternative 2 is provided in the CRP EA. The following discusses the effects common to both alternatives, with a separate section for additional effects associated with Alternative 2.

Project Design Features

The Forest Service has the statutory authority to regulate, permit, and enforce land use activities on its lands that affect water quality and is responsible for implementing nonpoint source pollution controls and meet Idaho Water Quality Standards. To comply with State Water Quality Standards, the Forest Service is required to apply water quality practices in State Forest Practices Regulations, where applicable, reasonable land, soil, and water conservation practices, or site-specific BMPs. These practices are designed with consideration of geology, land type, soil type, erosion hazard, climate, timing, cumulative effects, and other factors in order to protect and maintain soil, water, and water-related beneficial uses, and to prevent or reduce nonpoint source pollution.

The Camp Robin Project EA contains a full list of project design features to protect aquatic resources (W-38).

All practical measures to minimize sediment production are included in Alternative 2 including water resource protection in the planning, design and implementation phases

Modern forest practices greatly reduce or eliminate potential for negative water quality impacts. The 2016 Idaho Interagency Forest Practices Water quality Audit (*IDEQ 2016*) (W-36) describes how the erosion control measures observed in the state-wide audit are generally effective when properly installed and maintained. This audit also acknowledged the Forest Service had 97% compliance during the last 4-year audit cycle and averaged 99 percent compliance with BMP rules since 1996. The same audit also found slash mats were the most practical method for controlling erosion from skid trails, and road measures, such as gravelling, rocking ditches, installing rolling dips and waterbars were effective at reducing erosion. This is corroborated by the FS WEPP:Road erosion modeling results, the literature review of research on BMPs conducted by *Edwards et al. 2016* and also by local monitoring.

Stream reaches immediately downstream of vegetative disturbance are more likely to be directly or indirectly affected by vegetative disturbance (*Gresswell 1999, Benda et al. 2003*). BMP monitoring of past buffers on units has shown that INFISH RHCAs protect instream conditions from vegetation treatment effects in terms of sedimentation (W-20).

Standard and site-specific BMP to protect soil and water, and practices as described in the Soil and Water Conservation Practices (SWCP) Handbook (FSH 2509.22 USDA 1988), are included as design features and would be applied during timber harvest, and road decommissioning, maintenance, and reconstruction, to minimize soil erosion. The BMP techniques and their effectiveness are documented in several publications (*Seyedbagheri 1996; Idaho DEQ 2001; W-20*). They have been shown to maintain acceptable soil productivity (*Seyedbagheri 1996*) and minimize sedimentation. The SWCP Handbook (USDA Forest Service 1988) outlines BMP that protect soil and water which meet or exceed Idaho Forest Practices, Rules, and Regulations. All BMP applicable to the CRP can be found in project file W-4 and effectiveness monitoring of associated practices is located in W-20.

The BMP would have a high effectiveness in minimizing soil compaction and displacement (i.e., erosion), address seeding of disturbed areas, leaving course woody debris, limiting operations when soil moistures are high (on roads as well), and addressing conduct of logging. Design features also require piling machinery to use existing trails and to stay on slopes less than 40% to prevent soil disturbance in excess of guidelines. Design features for grapple piling require operation of equipment over slash mats whenever enough material is available; preferentially reusing existing skid trails if present. Forest plan monitoring and research indicates a reduction of soil disturbance if equipment is operated on a slash mat (Soils Report).

Monitoring results, which indicates effectiveness of stream buffers in protection of streams from management, from the PACFISH/INFISH Biological Opinion (PIBO monitoring across the Upper Columbia River Basin) demonstrates improving trends in pool depth, bank stability, large wood frequency and volume in both reference and managed sites (*USDA Forest Service 2012 and 2016*) (W-21). A summary of PIBO data collected between 2001 and 2013 just within Region 1 (W-22) of the Forest Service showed desired trends in all parameters except for percent pools (*USDA, 2016, unpublished report*)(W-23). Percent pools had a relatively small overall 2% decrease where increases would have been expected (which could be in part due to the variability of LWD inputs or movement within some of the study reaches). The overall percent pool tail fines (a measure of fine sediment) decreased by 14% within the region which is the desired trend for sediment, indicating that stream buffers and BMP's may work to reduce sedimentation and potential for channel degradation.

The *2017 PACFISH/INFISH Biological Opinion (PIBO) monitoring report* which measures the overall effectiveness of BMP's and riparian buffers indicates that managed (i.e. logging, fuels treatments, road management, etc.) streams/watersheds within Moyie and Kootenai river basins are either improving or static in terms of water quality and and/or aquatic habitat (W-7) which points to the strong likelihood that BMP's and riparian buffers are effective in protecting and/or maintaining the local aquatic environments from anthropological caused effects.

As displayed in the soils report, practices are designed to minimize the detrimental impacts of soil compaction, displacement (i.e., erosion), severe burning, and nutrient and organic matter depletion on long-term soil productivity. The use of these practices would insure that the soil quality standards listed in the 2015 Forest Plan and Regional Soil Quality Standards would be met.

Hillslope large woody debris (LWD) is essential for maintenance of sufficient microorganism populations and long-term ecosystem function, as well as preventing and/or minimizing erosion (i.e., sedimentation). Design features are incorporated into the activities to manage large woody debris and organic matter as detailed in the research guidelines contained in Graham and others (1994) (Soils Report).

Direct and Indirect Effects to Water Quality - Alternative 2

Effects to Sediment from all Proposed Road and Trail Work Including Temporary Roads

All practical measures to minimize sediment production are included in Alternative 2 including water resource protection in the planning, design and implementation phases

Forest roads can be chronic sources of sediment because road construction, use, and even some maintenance can tend to compact soils, reduce infiltration, intercept and concentrate surface and subsurface runoff, and limit growth of vegetation.

With this alternative, up to 35 culverts would be removed and up to 10 culverts would be upgraded or improved to reduce risk of erosion and sedimentation and to provide for adequate flow.

For alternative 2, best management practices (BMP) would be incorporated into all road work which has been shown to protect water quality and beneficial uses (W-20-23).

The combined road and/or road prism management proposed in alternative 2 would provide a net reduction in sedimentation to streams within the proposed treatment area long-term with minimal short-term sediment delivery potential. Modeling projections indicate a reduction in sediment delivery of approximately 1.2 tons per year collectively can be achieved from the proposed road management actions, which includes not only storing roads and rendering them inert hydrologically by removing culvert and decompacting road surfaces, but also properly installing ditch relief culverts before each perennial stream crossing, and graveling the driving surface over the crossings, adding drainages dips and outsloping roads to be used to facilitate the vegetation treatments. Installing ditch relief culverts before stream crossings disconnects the ditch from the stream and allows sediment to filter out across the forest floor. Increasing the size of culverts would reduce the risk of failure as a result of insufficient capacity and blockage.

Detailed WEPP modeling road data and results of the proposed road work can been seen in (W-25). Alternative 2 proposes to hydrologically store (make hydrologically inert) a total of 12.04 miles of road within the project area, including approximately 5.49 miles of currently open (to all traffic) roads, which would result in a reduction in sedimentation risk over the existing condition. Road storage would remove high risk drainage structures and install additional drainage structures, such as waterbars, to make the road stable, hydrologically inert and reduce hydrologic risks. Stored roads should need no maintenance when in storage but remain on the FS inventory for possible future and emergency use. Culvert removals could be accomplished with machinery or by using explosives. There would be short-term increases in sediment and turbidity during removal of culverts. A 2007 study of culvert removals reports an average sediment delivery amount of about 150 pounds; however this amount can be reduced to about 4 pounds using appropriate BMPs (*Foltz et al. 2007*).

Alternative 2 proposes to reconstruct approximately 9.8 miles of currently open road that would improve the roads and their drainage, including proper culvert sizing, graveling, additional storm drainage directed away from streams, outsloping (to focus drainage to the forest floor instead of stream courses), and cutslope stabilization in a manner that would decrease risk of sedimentation over the existing conditions. Removal of high risk drainage structures and installing additional drainage structures, such as waterbars and rolling dips and aggregate to make these reconstructed roads more stable and less prone to erosion and sedimentation would further reduce hydrologic risks.

Alternatives 2 proposes to reconstruct approximately 7.23 miles of currently gated or barriered road that is not currently hydrologically risk free or inert due to the existence of drainage structures that remain. These road segments would be reconstructed for temporary use, then would be stored upon project completion in a manner that would render the segments hydrologically inert which would be a long term improvement over the existing condition.

Alternatives 2 proposes to construct 6.49 miles of temporary road on existing road prisms causing no new ground disturbance. Upon completion of the project this temporary road would be fully re-contoured effectively rendering the existing prism more productive for vegetation growth and the site more conducive to natural hydrologic function and less prone to erosion.

Alternatives 2 proposes to block, secure and/or re-contour 2.1 miles of old road prisms to ensure no future unauthorized usage by OHVs. Although this activity is currently unauthorized on these prisms, this action would effectually secure these areas and eliminate potential for ground disturbance rendering the existing prism more productive for vegetation growth and the sites more conducive to natural hydrologic function and less prone to erosion.

Alternative 2 proposed activities such as 6.65 miles of temporary road construction on ground without an existing prisms, would pose some sort term risk of sedimentation however the vast majority of this temporary road would not be near streams and would mostly be located near ridges or at mid slope away from riparian areas. BMPs and operational windows would reduce potential for short term sedimentation and the eventual obliteration of these temporary roads would eliminate potential for long term erosion.

Alternatives 2 proposes to add 1.1 miles of old road prism to the FS road system, bringing the prism up to Idaho Forest Practices Act standards for drainage, and then storing the road, rendering it hydrologically inert long term. This action likely secures this road from unauthorized motorized usage and therefore would eliminate ground disturbance rendering the road more conducive to natural hydrologic function and less prone to erosion because the prism would not become rutted from tires and would allow for undisturbed vegetation growth.

Alternative 2 proposes to convert 3.06 miles of old road prism currently receiving some unauthorized OHV usage to the FS greater than 50" OHV trail system, bringing the prism up to BMP standards but allowing motorized usage. This action would authorize motorized usage and would likely increase ground disturbance slightly; however, implementation of BMPs would likely reduce potential for sedimentation rendering the trail more conducive to natural hydrologic function and less prone to erosion over alternative 1

As stated above, with alternative 2 there would be about 5.49 miles, of existing open road (to all traffic) road that would be closed/stored (removing culverts, improving drainage and eliminating high risk sediment source potential) and would be rendered hydrologically inert. Riparian road densities can provide a relative measure of road-stream interaction and the relative risk for increased flows and sediment input into the hydrologic system. Overall this action would reduce riparian road densities by about one mile and the potential for decreased water quality from erosion due to rutting and other potential road damage near streams. This lower road density within riparian habitat conservation areas would help decrease the probability of modifying flows and decrease the likelihood of contributing sediment into stream networks

The proposed mountain bike trial construction would follow strict guidelines included in the IPNF forest plan, leading to the protection and avoidance of riparian areas or wet areas and would not cause sedimentation issues due to the implementation of protective measures (Recreation and Inventoried Roadless Areas Report pp 36-37).

Alternative 2 proposes to provide road maintenance in accordance to BMP's on 54 miles of road. Road maintenance can cause short term minor erosion from exposed soil from clearing ditches of debris and vegetation. However cleaning diches of debris can also reduce potential for ditch flow to be pushed on to or captured by the road prism which can cause prism gullying, erosion and failure. Road maintenance reduces erosion and sedimentation by reducing risk of road failures, stabilizing cutslopes, improving dips (moving flow and sediment onto the forest floor away from streams) and prism drainage, removing berms and cleaning/clearing culverts (reducing risk of failure) (*IPNF Road Maintenance Programmatic* W-26). The benefits of road maintenance for this project likely outweighs the potential for minor sedimentation from maintenance activities because reducing the risk of culvert failures and road failures and improving dips, removing berms and improving prism drainage does more to reduce sediment potential in the short term and the long term than would be produced from cleaning ditches.

FS WEPP:Road considers traffic levels so predicted sediment delivery values reflect high traffic conditions, which would describe traffic levels associated with the timber harvest operation. Increasing the size of culverts would reduce the risk of failure as a result of insufficient capacity and blockage. BMPs will be incorporated into all road work since they have been shown to be protective of water quality and beneficial uses (*Seyedbagheri 1996*, *IDEQ 2016*, *Edwards et al. 2016*).

Some road reconstruction and maintenance activities, such as blading and ditch clearing, can increase the susceptibility of erosion on the road and ditch surface for a short time (days to weeks) after the work by making fine particles more available to movement. This increase can be mitigated by employing BMPs such as timing road blading to when soil moisture conditions are appropriate, or applying water with a tanker truck while grading during the dry season. Other BMPs that would be effective reducing sediment delivery in the short term are seeding, and using a roller to compact the surface after blading. Regardless, the long term benefits of improving drainage and armoring road surfaces would outweigh any short term increases as a result of maintenance and reconstruction activities.

Sediment delivery from increased traffic due to logging would not be expected on used routes due to limited proximity to streams coupled with the inclusion of road reconstruction and BMPs described above.

All Temp road construction would be near ridge tops or mid-slope away from live streams and the temporary existence of these roads would likely not cause appreciable erosion or water yield changes. Almost 50% of the proposed temporary road construction would occur on existing/old road prisms which would minimize new ground disturbance. The vast majority of the temp road construction would occur of stable land types with minimal potential for erosion (see Soils Report). Temporary roads would be obliterated after harvest activities (within approximately 3 years of completion of vegetation treatments).

No impacts to sediment delivery would be expected from this source because the pit and access road are located on suitable terrain and are well away from streams and waterbodies.

Effects to Sediment from Vegetation Prescriptions

Alternative 2 would treat vegetation across the landscape that currently possess an elevated risk of higher wildfire intensities due to fuel build up and stand structure (see Veg and Fuels Report). Therefore the area watersheds and riparian areas (RHCA's), including protective areas adjacent to wetlands/peatlands would be at a reduced risk of high intensity wildfire (Fuels Report) intrusions that, if were to occur, could cause high amounts sedimentation and erosion through the loss of wide spread riparian vegetation and subsequent hillslope and stream bank destabilization. Excess sedimentation to streams or wetlands/peatlands could negatively impact hydrologic system function, water quality and aquatic habitat.

Disturbed WEPP was used to estimate sediment delivery from proposed timber harvest and burning prescriptions for Alternative 2. Modeling results indicate that the action alternative would not increase sediment delivery over existing conditions (W-27-28). Units with proposed pre-commercial thinning prescriptions were not modeled because they would likely be completed by hand sawing and would have negligible ground disturbance. Also, if machinery such as a masticator were to be used, there would be minimal ground disturbance due to the copious amount of slash and plant material acting as ground cover. Sediment modeling data in addition to research studies and monitoring results conducted on the Idaho Panhandle National Forests verify that when riparian habitat conservation areas are incorporated into timber sales, sediment delivery to stream channels is not measurable or is negligible (*Reid and Hilton 1988; Belt et* *al. 1992; USDA Forest Service 2000b*).

Timber harvest prescriptions include design features and BMPs to minimize soil disturbance. The CRP EA includes a detailed list of design features and BMPs such as timing restrictions to ensure project activities only occur when soils are not saturated (See EA). Potentially sensitive areas, including areas near known past mass failures, were excluded from units during project preparation and layout phase (Soils Report). Units that would be skyline logged create minimal ground disturbance. Ground skidding would be completed using measures such as slash mats and designated skid trail locations to reduce compaction.

Proposed treatment in a small amount of wetland RHCAs within the STA's found in unit 39, 43 and 44 would promote aspen and would improve wetland function long term to a more natural state. Fire suppression has allowed conifer species to outcompete much of the Aspen in these areas. No ground disturbance would occur given the design criteria in the wetland areas to be treated within the STA's (see EA).

Coarse woody debris would be maintained in units that are currently within the recommended ranges and raised in units that are below. Units in excess of those recommended levels would be lowered through fuel reduction activities. Maintaining coarse woody debris on the landscape would greatly decrease potential for erosion and sedimentation due to the stabilization of hillslope soils. Potential sensitive areas, including areas near known past mass failures, were excluded from units during project preparation and layout phase. As depicted in table 6, most areas would be ground based at 70% and 30% skyline or helicopter (creates minimal ground disturbance). Ground skidding would be completed using measures such as slash mats and designated skid trail locations to reduce compaction (see the Soils Report). No ground based regeneration harvest would occur on acres rated as have having high mass failure potential. While these areas have been rated as having a high mass failure potential, no evidence of mass failure was found in these units during field work (Soils Report).

Table 6. Acres of harvest activities on high mass failure potential landtype

Vegetation Prescription	Logging Method	Alternative 2 Total Acres	Alternative 2 Total Acres on rated MFPL
Regen	Skyline/Helicopter	~454.0	108
	Ground Based	~2720.0	0
Commercial Thin	Skyline/Helicopter	~1242,0	167
	Ground Based	~1390.0	31
Total		5806 ac	306

Harvest activities are proposed in landtypes rated with low surface erosion potential on 98 percent of the proposed activity areas in alternative 2. There are no acres that rate as high for surface erosion. Sediment modeling data in addition to research studies and monitoring results conducted on the Idaho Panhandle National Forests verify that when riparian habitat conservation areas are incorporated into timber sales, sediment delivery to stream channels is not measurable or is negligible (*Reid and Hilton 1988; Belt and others 1992; USDA Forest Service 2000b*).

The two municipal water supplies, previously discussed, located in Mission Creek and in Meadow Creek (W-2) would not be negatively impacted by the proposed activities (W-30). The proposed activities would only produce minimal short term sediment from road work. The proposed road work would ultimately reduce sedimentation potential and risk long term. BMP and design features would be required and would greatly reduce potential for sedimentation to these streams. Water yields fluctuation are not expected to negatively affect the existing stable reaches near or above the water supply sites, because of the limited proposed harvest in Mission Creek and the stable and resilient existing stream channel conditions in the associated reaches of Mission creek. The water supply intake in Meadow Creek is located upstream of the proposed activities so no project related effects are anticipated.

Alternative 2 proposes about 386 acres of burn only units. A negligible increase in sediment yield to streams would be expected from the burn only units. The surface condition after a prescribed fire is typically a mosaic-like pattern of low severity, high severity, and unburned patches (*Robichaud 2000*). The patterns of burn severity help control the spatial scale at which the effects of prescribed burning can be detected (*Troendle et al. 2010*). The patchiness of burn severity allows unburned and low severity patches to infiltrate runoff and trap sediment that is generated on adjacent high severity patches (*Biswell and Schultz 1957; Cooper 1961; Swift and others 1993*). This project would include design criteria which excludes ignition within RHCAs. This would limit the fire severity and subsequent consumption of litter and surface roughness which traps sediment before it is delivered to the stream. Fire would be allowed to back into RHCAs but the intensity would be expected to diminish due to the increased shade, humidity, and fuel moistures found in riparian areas; and would be expected to have generally beneficial results. *Dwire and Kauffman 2003* reported that prescribed fire may top kill certain riparian trees and shrubs but is unlikely to negatively affect belowground structure. This indicates the bank-stabilizing properties of the riparian vegetation is preserved and the trees, shrubs and forbs would recover quickly. The prescribed fires would have specific criteria to limit the severity of the fires included in the burn plans such as; constraints on fuel, duff, and soil moistures, weather conditions such as relative humidity, areas to exclude ignition, etc. Fire intensity would be further controlled and adjusted during implementation by modifying the patterns of ignition. Additionally, burns would likely be initiated a short time before wet weather is expected. The burn only units would be completed in parts over a time span as long as ten years, as favorable burning conditions occur.

With alternative 2, wetlands and peatlands would be protected by vegetated buffers and by greatly limiting ground disturbance in these areas. Sedimentation and erosion can reduce the function, diversity and size of peatlands. Buffers for the peatlands would extend 660’ from the edge of the peatlands as per 2015 IPNF Forest Plan guidance or to the nearest slope break (hydrologically disconnected from peatland) or to the road/buffer intersect at FS road 2274. The road/buffer intersect at FS Road 2274 would likely be an effective buffer distance from the edge of the peatland adjacent to unit 14 given that sediment moving across the road from the upslope treatment area to the downslope buffer is unlikely (W-29). This is due to the large remaining no treatment buffer below the road, the functioning condition of the road and the use of BMP which would reduce potential for sedimentation from leaving the road. FSWEPP estimated no sediment delivery to peatland given the proposed buffer condition, layout and extent (W-29).

Water Temperature

Direct incoming solar radiation is the dominant energy input for increasing stream temperatures with shade being the single most important variable to reduce this heat input (*Gravelle and Link 2007, Krauskopf et.al. 2010*). Of the proposed actions, timber harvest and to a lesser degree, landscape burning are the activities that could potentially increase the amount of solar radiation reaching the streams. Through the implementation of the INFS (USDA 1995) and the incorporation of RHCAs into the CRP, the proposed activities would not further degrade water quality with respect to temperature because RHCAs would retain the canopy cover that prevents solar inputs to the stream.

Required riparian habitat conservation areas would retain canopy cover provided by trees along the streams (PNV protection as required by the project area TMDL’s, IDEQ 2014-17) and prevent degradation of water quality with respect to temperature in either alternative. Alternative 2 would reduce the potential impacts of wildfire (reduce riparian shade) by reducing surface fuels, and canopy densities and lowering flame length, rate of spread and fire crown fire activity.

This project proposes about 5 acres of timber harvest within riparian habitat conservation areas along the main Mission Creek Channel in unit 38. This proposed activity within the RHCA is not expected to be detrimental to stream temperatures because the natural topography, slope breaks and location of the proposed unit will protect streams and streamside resources. Within unit 38, Mission Creek will maintain at least 150 feet of undisturbed vegetation between the unit and stream given the natural slope breaks.

Gravelle and Link (2007), found that the use of 75 foot riparian buffers effectively negated the effects of timber harvest (partial-cut and clearcut) impacts on stream temperatures in the reaches directly below harvested areas. This project will incorporate buffers that meet or exceed those described in the 2007 study. Work in unit 38 would harvest a decadent stand with prevalent insect and disease and would promote the regeneration of longer lived species such as white pine and larch, which would be beneficial to the riparian area when established. Special design features are included for this unit (see EA). Field reviews of project area streams documented dense, intact overstory and understory vegetation adjacent to the Mission Creek in unit 38 providing extensive canopy cover.

Direct and Indirect Effects to Watershed Function - Alternative 2

Stream Channel Stability and Wetland Stability

Effects from vegetation and road treatments
As discussed above there would be a net decrease in sedimentation and reduce risk of road/stream crossing failures with Alternative 2. In general this would help to maintain or improve channel stability.

Based on findings in *Grant and others (2008)* for rain-on-snow dominated landscapes, existing peak flow changes within the project area defined catchments may currently be undetectable given the limited recent regeneration type canopy removal in the past 30 years (W-12, 19 and 31), vegetation regrowth in areas with past openings across the analysis area and wildfire exclusion (Vegetation Report and Fire and Fuels Report).

Overall the analysis area streams are not be particularly susceptible to erosional processes from annual flow fluctuations, with or without management, given their morphological characteristics that have inherent stable and resilient characteristics. As previously discussed, *Grant et al. (2008)* found that peak flow effects on channels are generally confined to reaches where the channel gradient is less than 2% and streambed and banks are composed of gravels and finer materials. Stream channels or channel segments within the project area that have channel gradients less than 2%, and made up of fine materials are limited, based on field reviews, to approximately 3% of the total stream channel length within the project area (Meadow, Brush, Mission, Gillon, Fry, Round Prairie Creeks and the Moyie River combined) (W-5 and 8). This is due to the natural morphological characteristics of the analysis area streams and landscape, which are mostly 1st or 2nd order higher gradient smaller steams with larger stream bed material, angular rock, and other energy dissipating elements such as abundant large woody debris (LWD) (W-8). The only sustained lower gradient areas within the project area are found reaches of Round Prairie Creeks and lower Mission Creek (W-8).

The Proper Functioning Condition (PFC) assessment assessed the hydrology, soils, and vegetation of riparian areas in the project area to rate the health, stability and state of physical processes of streams. Several factors can limit channel functionality, which include a lack of large woody debris, inadequate riparian vegetation (i.e., structure and composition), and excessive bank erosion and channel aggradation.

Overall, analysis area stream channels were found to be stable, resilient, and well vegetated maintaining good amounts of LWD and other stabilizing structures, such as boulders and larger angled rock supported by vertical bed rock controls. Furthermore the project area stream channels appear to have maintain stability and resiliency over time given the well vegetated stream banks, abundant in channel LWD structure that has evidently remained intact and in place within the channel overtime. Point bars and substrate appear to have had little movement or disturbance over time given the abundant substrate mosses and other riparian plant growth in these areas. Because of the project area streams stable conditions and inherent resiliency to flow fluctuations, stream channel conditions would likely remain unaffected by water yield/peak fluctuations that have occurred over time, that are currently occurring and that may occur due to the proposed vegetation treatments given the exclusion of stand replacing wildfire (W-8 and table 4).

In forested ecosystems woody debris plays a particularly important role in smaller 1st and 2nd order streams (which is the majority of the stream in the project area), since it slows stream flows, dissipates energy, stores organic and sediment materials, and decreases potential for channelization and loss of fine material (*Jackson and Strum 2002*).

In terms of morphology, potential stream channel areas or stream sections at risk from peak flows fluctuations, caused by ROS, are extremely limited in the analysis area (W-5 and 8).

Grant and others (2008) generally concluded that when 15% of canopy is removed or harvested within a defined watershed, detectible changes (> 10%) in peak flows were made in rain-on-snow (ROS) dominated landscapes, and generally, peak flow changes may likely be undetectable if less than 15% of an area is clear-cut harvested within a defined watershed. A compilation of research on paired catchment studies for water yield increases showed that a canopy reduction of 20% or less will not show a measurable increase in annual water yield *(Stednick, 1996, p. 90*).

No new permanent road construction would occur with this project thus no new long term copy openings would occur from this type of activity. Temporary road would be mostly be built within units to have treatment or on existing road prisms and would all be obliterated upon the project completion.

Table 7 displays a summery and discussion regarding potential changes in peak flows/water yields by catchment area.

Proposed vegetation treatments (canopy openings from regeneration type harvest) would be spread out across several unconnected drainages greatly minimizing potential for any measurable water yield/peak flow changes at a defined catchment or watershed scale. This total does not include thinning or prescribed burning units because these units would retain the majority of their vegetative cover and would generally maintain existing evapotranspiration and interception capabilities.

Of the acres proposed for vegetation treatments only 55% would be regeneration type leading to new canopy openings within the project area. Therefore the proposed action would increases forest canopy openings spread across approximately 6% of the entire project area from regeneration type harvest.

At the 6th code HUC scale (large watershed) the drainages effected by the proposed action leading to regeneration type canopy removal would range from approximately 5% - in the Round Prairie Creek Watershed to .5% in the Dawson Lake Watershed. Detectible peak flow increases in large basins will almost invariably be less than those in small watersheds, suggesting that the response lines for small watersheds represent maximum increases for all size watersheds (*Grant 2008*). When assessing effects of canopy openings at a smaller (portion of the 6th code HUC found within the project area) scale, flow changes/fluctuations may be much more detectible (i.e., > 10%) (W-19).

Of all the drainages areas in the project area the 23% portion of Round Meadows Creek 6th level HUC has the most acres of canopy removal within a defined area at 22% of the 5519 acres within the project area which may constitute a measure change in flows when viewing at this smaller proportional watershed scale. Still, at the Round Meadows Creek 6th level HUC scale only 5% of the canopy would be removed using regen harvest (W-19). These percentages do not include thinning or prescribed burning units because those area/units would retain the much of their vegetative cover and would generally maintain existing evapotranspiration and interception capabilities.

Based on *Grant 2008 and Stednick 1996*, assertions as stated above, proposed regeneration harvest may cause slightly detectible changes in peak flows at the project area scale in the Gillon and Mission Creek which would reduce canopy cover a small amount/percentage relative to the sizes of the proportional to the project area drainage area that it occurs in.

The other previously mentioned streams/watershed areas found in the project area would likely have no detectible changes in water yields/peak flows given the limited amount of proposed regeneration type harvest activities relative to the sizes of the proportional to the project area drainage areas they occur in.

Detectible changes to water yield/peak flow caused by the proposed regeneration type harvest activities would be unlikely when assessing canopy removal proportionally on the acres of the 6^{th} code HUC scales.

Grant et al. (2008) found that peak flow effects on channels are confined to reaches where the channel gradient is less than 2% (i.e., relatively low gradient), and streambed and banks are composed of gravels and finer materials which are relatively limited in the project area streams. There is little lower gradient channel reaches, or fine material streambeds or banks, found within the analysis/project area (only about 3% of all project area stream channel mostly found in Meadow Creek). Mission Creek and Gillon Creek average stream gradients much greater than 2% (W-5 and 8 and table 4) making them less susceptible based on this assertion. Mission Creek and Gillon Creek assessed reaches were both found to be in proper functioning condition (PFC). This is mainly due to the natural morphological characteristics of these streams and landscape, which are mostly higher gradient steams with larger stream bed material, angular rock, and other energy dissipating elements such as abundant large woody debris (LWD) and heavily vegetated stream banks and riparian areas (W-8 and table 4).

Large storm events tend to saturate catchments to a point where the degree of forest cover becomes insignificant. Increased stream flow as a result of cover reduction is more likely from events with frequent return periods, as shown by *Grant et al. (2008)*. Protective riparian and stream bank vegetation commonly protects channels from small to moderate floods. Forests can mitigate small and local floods, but do not appear to influence either extreme floods or those at the large catchment scale. Where riparian vegetation is well established and floodplains are intact, the risk of channel degradation from increased management-induced streamflow is quite low.

Historically, under natural conditions forest canopies where likely more open than they are to given the exclusion of wildfire.

All activities proposed in alternative 2 combined has the potential to equate to new canopy openings on approximately 14% on the combined watershed areas within the project area. Of this 14% about only 7% constitutes regeneration harvest type and the other 7% would effectively be thinning (retaining effective evapotranspiration i.e. water uptake). The Gillon Creek watershed project area portion of the Round Meadows Creek 6^{th} level HUC would have vast majority of new openings from regeneration harvest totaling about 1240 acres of the 5519 acre portion/scale (22%) of which is mostly on previously harvested areas (W-11 and table 7). The Missions Creek watershed project area portion of the Mission Creek 6^{th} level HUC would have new openings from regeneration harvest totaling about 707 acres of the 2105 acre portion/scale (33%) of which is mostly on previously harvested areas (W-11 and table 7) however this % is based on assessing at a small scale relative to the entire watershed (6^{th} level HUC). At that scale there would be only 3% new canopy openings which would not be detectible.

In terms of existing riparian conditions, function and morphology, potential stream channel areas or stream sections at risk of being negating impacted by peak flows fluctuations, caused by ROS, are extremely limited in the project/analysis area (W-8).

Table 7. Effects of regeneration harvest on water yield/peak flows within individual catchments within the project area

Watershed Name	Total watershed size (acres)	Defined portion/catchment area within project area boundary (acres)/% of total of the associated 6th level HUC	% Area within the project area portion/catchment proposed for regeneration harvest treatment (new canopy openings)	Discussion of direct/indirect effects to water yields/peak flows
DL – KR (Fry Creek)	20174	4002/20%	0%	83 acres of thinning only within catchment. No changes in water yield/peak flows expected.
BL – KR (Brush Creek)	25111	5455/21%	13%	750 acres of regeneration harvest within catchment. No measurable changes in water yield/peak flows expected.
MC (Meadow Creek)	15598	15598/100%	2%	282 acres of regeneration harvest within catchment. No changes in water yield/peak flows expected.
MC (Mission Creek)	20029	2105/10%	33%	707 acres of regeneration harvest. Very small assessed catchment relative to harvest amount elevates the % new canopy opening. Slight measurable changes in water yield/peak flows may occur within the project area reaches of mission creek but would be unmeasurable at a larger basin scale.
RC– KR (Rock Creek)	18890	5431/28%	10%	558 acres of regeneration harvest. No measurable changes in water yield/peak flows expected.
RMC (Gillon Creek trib to Round Prairie Creek)	23858	5519/23%	22%	1240 acres of regeneration harvest. Slight measurable changes in water yield/peak flows may occur within the project area reaches of Gillon creek but would likely be undetectable at a larger basin scale.
CC – MR (Moyie River)	18198	1241/6%	30%	375 acres of regeneration harvest. Very small assessed catchment relative to harvest amount elevates the % of new canopy opening proportionally. Slight measurable changes in water yield/peak flows may occur within the project area adjacent ephemeral reaches (1st order streams) but would be unmeasurable and undetectable at a larger basin scale or within the any reach of the Large Moyie River.

Although Gillon and Mission Creek may show some temporary water yield peak/flow fluctuations based simply of the amount of proposed regeneration harvest treatment acres within the defined portion/scale of the larger watershed (Grant 2008), appreciable degradation of any stream channels resulting in water resource damage or reduced water quality within the project area due to increased water yield/peak flows is not expected. The amount of regeneration harvest within Mission Creek and Gillon Creek at the 6th level HUC scale or any of the other watersheds would not produce measurable water yield/peak flow fluctuations (table 7). PFC assessments and other stream survey information indicate that the major perennial streams within the analysis area, including mission Creek and Gillon Creek are functioning properly, are highly stable and contain abundant amounts of woody debris that dissipates flow energy and provides stream bank stabilization (W-8).

Temporary (until opened canopy cover becomes well reestablished) water yield increases and/or peak flow fluctuations may be expected within the Mission creek and Gillon Creek catchment areas found within the project area given the proposed regeneration harvest activities. However, potential changes or fluctuations in water yields or peak flows in in these catchments area not expected to affect stream channels or water quality due to the overall proper functioning conditions and geomorphological characteristics indicating stable and resilient stream channels that have shown no negative effects from past natural and/or unnatural canopy reducing events; given its intrinsic ability to facilitate increases in water yield and/or peak flows without causing appreciable degradation (W-8); and due to the resilient stream channel types consisting of practically minimal low gradient channels (i.e., < 2% slope) (W-5) consisting of fine materials. The other defined catchment area (table 7) stream channels or water quality would unlikely be affected by increased flows or flow fluctuations given the minimal proposed canopy openings and the overall proper functioning conditions, indicating mostly stable and resilient (i.e., no discernable effects from past flooding) stream channels able to facilitate increases in water yield and/or peak flows (W-8)), and due to the resilient stream channel types having minimal low gradient (i.e., < 2% slope) consisting of fine materials. The combined catchments areas with proposed activities account for 39,391 acres of the total project area. Regeneration harvest proposed for this combined area would contribute only about 8% to new forest canopy openings within this area. However 65% of this proposed harvest is on previously harvest areas.

During a storm event, roughness (coarse woody debris and surface ground cover) impacts resistance to flow and plays an important role in the generation and transport mechanisms of surface runoff, sediment delivery pathways, and nutrient distribution. Ground cover (course wood) can increase roughness which slows surface flows and reduces erosion and increases infiltration (*Katul et al., 2011*). BMP's, which require leaving appropriate levels of coarse woody debris on hillslopes after treatment (Soils Report) and INFISH buffers are expected to further protect instream conditions from potential erosional process caused by timber harvest (W-20-23). Therefore, there would be no expected negative effects on overall stream channel conditions and/or water quality within the project area from timber harvest activities.

The proposed Pre Commercial Thinning (PCT) for Stand Improvement would have no direct effect on stream channel stability because work would be done on foot with hand-held tools and chainsaws in treatment units with riparian buffers.

Temporary road construction would be near ridge tops or mid-slope away from live streams and the temporary existence of these roads would likely not cause appreciable erosion or water yield changes. Almost 50% of the proposed temporary road construction would occur on existing/old road prisms which would minimize new ground disturbance. The vast majority of the temp road construction would occur of stable land types with minimal potential for erosion (see Soils Report). Temporary roads would be obliterated after harvest activities.

Project area stream channels are not expected to be negatively affected by the proposed road work due to the minimal amount of short-term sedimentation potential and the overall stable existing condition of the streams in the project area, combined with the use of BMP and design features (W-20).

WEPP modeling estimates that the proposed road would directly and/or indirectly reduce approximately 1.2 tons of sediment annually and into perpetuity (long-term) (W-25). This amount of sediment would likely be undiscernible at the project area scale because activities are spread out across several drainages on at least 12 different road segments. At the site scale (in and near the proposed work) in any given year, but could equate to a more notable amount over the long term (W-25). In general stream channels within the project area would likely have reduced annual sedimentation potential long-term. Overall, potential for improved water quality would increase within the analysis area over the long term, and more specifically adjacent to the affected riparian areas and stream channels (W-25).

Potential Effects to Wetland and Peatlands
Some wetlands in the project area, especially the ones found within STA's in units 39, 43 and 44 would have an improved aspen component due to the discontinuation of conifer species intrusion. This may also lead to an improved annual water availability and storage capabilities within the wetlands which may benefit other riparian plant species (Botany Report, Vegetation report and Wildlife Report). Working within the RHCA wetland buffer would follow strict design features to eliminate potential for ground disturbance and or soil displacement.

Peatlands would likely remain unaffected because large buffers/and or natural slope breaks or flow path interception would greatly reduce erosion and sedimentation to peatlands which otherwise could reduce their size and function (W-29).

Effects to Municipal Watersheds
The two municipal water supplies previously discussed in Mission Creek and in Meadow Creek (W-2) would not be negatively impacted by the proposed activities. The proposed activities would only produce minimal short term sediment from road work. The proposed road work would ultimately reduce sedimentation potential and risk long term. BMP and design features would be required and would greatly reduce potential for sedimentation to these streams. Water yields fluctuation are not expected to negatively affect the existing stable reaches near or above the water supply sites. In fact the water supply outlet in meadow creek is located upstream of the proposed activities.

Cumulative Effects – Alternative 2

Past, Present, and Reasonably Foreseeable Activities Relevant to Cumulative Effects Analysis (W-33)

The following is a description of past, present and reasonably foreseeable actions that establish the appropriate geographic and temporal boundaries for the cumulative effects analysis. Activities identified below were considered relevant to the watershed cumulative effects analysis. Other activities listed in the CRP EA (e.g. tree planting, firewood gathering, etc.) are not discussed here because there are no measureable soil or watershed disturbance anticipated by these activities.

Fire suppression activities over the last century within the analysis area drainages have allowed, and would continue to allow, untreated stands to progress toward climax vegetation conditions. The current trend is toward increasing stand densities, which makes them more susceptible to insects, disease and risk of fires (Vegetation and Fire and Fuels sections). Since changes in water yield are associated with vegetation conditions, the existing and future trends would have an effect on water yield.

General motor vehicle, off road vehicle, and snowmobile use on roads and trails- motorized use (motorcycles, ATVs and snowmobile) use of the area may increase as motorized recreation popularity increases. Increased traffic and a lack of road and trail maintenance can cause in increase in erosion and sediment delivery.

Road maintenance activities occur annually to some degree within the watershed. These activities include, but are not limited to, blading, brushing, and ditch/culvert cleaning. Maintenance typically improves drainage and can decrease erosion from water channeling down the road surface. Culvert and ditch clearing lowers the risk of failures but can cause some short term sedimentation from exposed soil and reduced roughness.

Noxious weed treatment and monitoring – This activity would follow guidelines established in the Bonners Ferry Noxious Weeds Control project EIS (USDA Forest Service 1998) and may include supplemental methods (product) as discussed in the Fisheries Report and the CRP EA. Effects to aquatic resources were analyzed in that document and its adaptive strategy and would allow native riparian plant to flourish without negatively impacting water quality (See Fisheries Report pg. 31). No additional effects to watershed or fisheries are expected to occur.

Timber Stand Improvement – This activity (pruning, thinning, etc.) would occur outside RHCAs except where it could potentially improve riparian habitat. No ground disturbance would occur and timing restrictions would be enacted. No detrimental direct or indirect effects to watershed and fisheries are expected to occur.

Activities on private lands- Private land makes up about 18% of the Meadow Creek watershed. About half of the private land is composed of homes, farms and ranches, and the other half is owned by a private timber company. Some of the roads used for logging activities on private lands have increased and concentrated water flows, increased the potential for landslides and delivered sediment to Meadow Creek from road fill failures and road surface runoff. Sediment delivery levels from the private roads are based on the level of road maintenance activities. Grazing in riparian areas on the lower reaches of Meadow Creek is expected to continue.

Other past Activities and Events

Wildfires, timber harvesting, homestead, and road construction activities have occurred throughout the project area/analysis area watersheds. More information on historic timber harvesting can be found in the vegetation section of the CRP EA. These activities and their effects were analyzed using historic records and forest service vegetation management data and incorporated into the current baseline condition, along with a look at historic ranges of variability for the for the project area watersheds. This is discussed in the Affected Environment section of this document.

Road storage and decommissioning has occurred in the project area watersheds. Within the project area over 2.7 miles of road has been stored recently and over 8 miles of road has been decommissioned and 10.5 miles barrierd or blocked to motorized access. All of the recent activities within the project area has likely reduced sedimentation potential to some degree.

Cumulative effects to Water Quality for Alternative 2

Alternative 2 will have the greatest reduction in sediment production (W-25), with most attributed to the removal of up to 35 culverts on 13 different road segments. 8 of which are on FSR 2504 in the Wall Creek/Meadow Creek drainage. This reduction would not be realized with Alternative 1. The action alternative would see reductions in sediment from the road reconstruction, which will improve drainage and durability of the existing routes. The action alternative would also see a reduction in sediment risk from upgrading culverts as part of the proposed road reconstruction. There will be short-term increases in sediment and turbidity during removal and upgrading of culverts. Because of the potential negative effects to aquatic health and habitat in the event of culvert failures, the removal or upgrade of culverts will be a long-term benefit to watershed resources over the existing condition. As calculated, Alternative 2 will have a net reduction in sediment of 1.2 tons per year long-term (average annual amount). These reductions are realized by the combination of all proposed road work (W-25). This work will also result in slightly lower road densities within riparian areas upon project completion (W-34). The effect of which is expected to be a decrease in the probability of modifying flows and a decrease the likelihood of contributing sediment into stream networks.

Alternative 2 cumulatively addresses the purpose and need for action as presented in the CRP EA. It will trend forest health and fuel concerns in a more positive direction and reduce sediment entering the project area watersheds. Alternative 1 does not respond to the need for action and would not move towards achieving desired conditions as well as Alternative 2 does.

Sediment Delivery

The combination of direct and indirect effects of alternative 2 with past, present and reasonably foreseeable activities within the cumulative effects area would result in an overall net decrease in sediment yield to the project area watersheds upon project completion. As calculated, Alternative 2 would have a net reduction in sediment of approximately 1.2 tons per year (average annual amounts). These reductions are realized primarily by the proposed road reconstruction and storage. The road storage and decommissioning treatments would also reduce the risk of sediment delivery due to road failures but this amount is not included in the sediment modeling results. Harvest and burning treatments would result in negligible direct, indirect and/or cumulative sedimentation or erosion to streams (see above and W-27)

Within the project area, the ongoing activities and reasonably foreseeable projects, are not expected to increase sediment contributions to this watershed. Both projects would include the use of BMPs per the Idaho Forest Practices Act requirements (W-20-23). Sediment reductions would be realized with either action alternative proposed by this project. Regular road maintenance activities are expected to have a general beneficial effect toward aquatic resources through reduced sediment delivery and risk of road failures.

Roads and Road Density

Alternative 2 would reduce the overall road density in the project are as described in the direct effects section (W-34). The CRP project will store a total of 12.04 miles of road within the project area, including approximately 5.49 miles of currently open (to all traffic) roads, which would result in a reduction in sedimentation risk over the existing condition. Road storage would remove high risk drainage structures and install additional drainage structures, such as waterbars, to make the road stable, hydrologically inert and reduce hydrologic risks. That will further reduce riparian road densities in the project area (W-34). The road storage and decommissioning (blocking access and/or obliteration) proposed with CRP would complement the road storage that has already been completed in the watershed. Lower road density within RHCAs would help decrease the probability of modifying flows and decrease the likelihood of contributing sediment into stream networks.

Water Temperature

The combination of direct and indirect effects of the action alternatives with past, present and reasonably foreseeable activities would preserve the shade-providing riparian vegetation within the project area RHCAs. This would not further degrade water quality with respect to temperature because RHCAs would retain the canopy cover that prevents solar inputs to the stream. The riparian vegetation would continue to slowly improve as the stands grow and mature. The approximate 5 acres of timber harvest proposed within the RHCA of unit 38 would reduce canopy cover, though it wouldn’t impact stream shade because the unit would have 150 feet of undisturbed RHCA would be left between the unit and the stream. This project would be consistent with the intent of the CWA and the temperature TMDL’s within the project area streams (W-1-19).

Cumulative Effects to Watershed Function for Alternative 2

Watershed Function

Stream Channel Stability

Appreciable degradation of any stream channels resulting in water resource damage or reduced water quality within the project area due to increased water yield/peak flows is not expected. PFC assessments and other stream survey information indicate that the major perennial streams within the analysis area are mostly functioning properly, are highly stable and contain abundant amounts of woody debris that dissipates flow energy and provides stream bank stabilization (W-8 and table 4).

Within the project area forest canopies were more naturally open historically than they are today given wildfire exclusion and overstocking (Fire and Fuels report) indicating that past water yields and peak flow were not based on a 100% closed canopy system. The proposed vegetation treatment will in the end mimic more natural historic conditions and thus hydrologic conditions within the natural range of variability.

Changes to forest watershed hydrology (i.e., water yields and/or peak flows) may in theory cause diminished water quality to some stream channels because stream banks can become destabilized, increasing erosion and deposition potential.

Past vegetative treatments, road construction, wildfire, and past fire suppression have likely had some effect on the analysis area hydrology directly, indirectly, and/or cumulatively through changes of the hydrologic cycle. Change in canopy cover or density may affect transpiration, interception, snow accumulation, evaporation from the ground surface (e.g., wind velocity and radiation balance changes), sublimation, and organic material accumulation.

Fire played a central pre-settlement role in shaping the composition, structure, distribution, arrangement and function of vegetation within the Camp Robin project area. Fire suppression has had profound effects on the function of these systems and their biodiversity. Stand densities increased and fire-tolerant species have been widely replaced by fire-intolerant species such as grand fir, white fir, and small diameter Douglas-fir. This influx of shade tolerant understory species has altered stand structures as single-layer canopies have progressed towards dense, fire ladder laden, multiple-layer canopies which has had effects on expected fire behavior, as discussed in the Camp Robin (Fire and Fuels report). These shade tolerant, fire intolerant species tend to be more susceptible to insects and pathogens (Vegetation Report).

The largest lethal or stand-replacing fire in the project area burned in the 1890's and consumed about 16,000 acres, primarily in the northern portion of the project area. In 1945, the Brush Lake fire burned across about 4,500 acres of the southern portion of the project area in the vicinity of Brush Lake.

Since European settlement in the area at the end of the 19th century, the landscape in the project area has undergone substantial changes. In addition to the implementation of an aggressive fire suppression policy, logging in the first two thirds of the 20th century also had notable effects on the composition and structure of forest vegetation in the project area. This logging focused on easily accessible stands containing large trees Vegetation Report Report).

Large stand replacing wildfires that burned in the project area watersheds in the past (i.e., early 1900s and late 1800s [Fire and Fuels Report]) may have naturally caused relatively large sediment pulses from erosion, caused by, large areas of hydrophobic soils, loss of riparian vegetation and riparian LWD coupled with water yield and peak flow fluctuations due to reduced evapotranspiration. These past sediment pulses may have been much greater than any other natural or unnatural causes of sedimentation or flow fluctuations that have occurred in this watershed since there occurrences. This level of naturally caused increase in water yields, due to canopy reduction and subsequent reduction in evapotranspiration, would be considered within the historic natural range of variability for this analysis and watershed, and as a natural process.

Regulated timber harvest on Federal lands in project area began in the early 1970s and continued into the late 1990's. During this period, road systems were developed and even-aged silvicultural systems were used to create forest openings and regenerate early seral species in the absence of stand-replacing fire. However, these openings were generally limited to less than 40 acres due to requirements in the National Forest Management Act that place limitations on the size of openings created through even-aged timber harvest. Given this limitation, and the lack of recent stand-replacing fire, it is not surprising that the combination of small and medium size class forest comprises a large portion of the landscape and that the extent and size of patches of early seral forest vegetation is near the lower end of the historical range of variability at the Kootenai Subbasin scale (Vegetation Report).

More recent management efforts to pursue restoration and fuels reduction goals have had generally positive effects on forest composition, structure and pattern in the project area.

Watersheds associated with the project area at the 6th level HUC scale where characterized in 2011 by having mostly "low" ECA (equivalent clear cut areas or open canopies from vegetation management) (W-12). Most of the past timber harvest (which was a mix of regeneration and thinning type) occurred in the project area before 2000 (W-11) and almost all occurred before 2010. Intermediate harvest type left canopies with good retention and would have little effect on hydrology. These past harvested areas are likely not contributing appreciable sediment from erosion or runoff to streams at a site scale, or at the watershed scale, given protective vegetative stream buffers, natural vegetative recovery, site productivity reforestation, increased ground cover and a reduction in overall watershed roads and adjacent riparian roads. Within the project the vast majority of stands that received treatment (pre 1992) have likely vegetative recovered (based on aerial photography analysis and field reviews) to the point they are likely hydrologically stabilized on the landscape to near pre harvest conditions, given the exclusion of wildfire, which would result in increased evapotranspiration and interception of precipitation which reduces the potential for increased erosion and changes to water yields/peak flows. Previously harvested areas are likely not contributing any appreciable erosion or sediment to project area streams channels (W-8) and are well on their way to hydrologically recovering from the past vegetation treatments; due to vigorous second growth consisting of either large to medium sized trees, poles, shrubs, grasses, and other ground cover. Most of the previously harvested areas completed in the early 1990s and early 2000s are likely hydrologically stable (i.e., increased evapotranspiration rates and decreased runoff potential) and relatively well vegetated due to productive site conditions for vegetation growth (i.e., habitat types) that exist in the project area.

Temporary (until canopy cover becomes well reestablished) detectible water yield increases and/or peak flow fluctuations are expected within the Gillon Creek and Mission watershed given the proposed harvest activities within those drainages which reduces canopy cover by roughly 22% and 33% respectively within the small scale assessed catchments units of the project area/analysis area. However, detectible changes or fluctuations in water yields or peak flows at any of the 6th level HUC scale watersheds is not expected (W-19 and table 2, 4 and 7). Project are streams or riparian areas would not be negatively affected or water quality reduced due to the overall proper functioning conditions and geomorphological characteristics indicating stable and resilient stream channels that have shown no negative effects from past natural and/or unnatural canopy reducing events; given its intrinsic ability to facilitate increases in water yield and/or peak flows without causing appreciable degradation (W-8 and table 4); and due to the resilient stream channel types consisting of practically no low gradient channels (i.e., < 2% slope) consisting of fine materials (W-5-8 and table 4).

Overall stream channels and water quality would unlikely be affected by increased flows or flow fluctuations given the relatively minimal proposed canopy openings given the larger watershed scales (table 4 and the overall proper functioning conditions, indicating mostly stable and resilient (i.e., no discernable effects from past flooding) stream channels able to facilitate increases in water yield and/or peak flows (W-8), and due to the resilient stream channel types having minimal low gradient (i.e., < 2% slope) consisting of fine materials.

BMP and INFISH buffers are expected to further protect instream conditions from timber harvest (W-20-23). Therefore, there would be no expected negative effects on overall stream channel conditions and/or water quality within the project area from timber harvest activities.

Potential Effects to Wetland and Peatlands

Some wetlands in the project area, especially the ones found within STA's in units 39, 43 and 44 would have an improved aspen component due to the discontinuation of conifer species intrusion. Cumulatively, this may also lead to an improved annual water availability and storage capabilities within the wetlands which may benefit other riparian plant species (Botany Report). Working within the RHCA wetland buffer would follow strict design features to eliminate potential for ground disturbance and or soil displacement.

Peatlands would likely remain unaffected cumulatively because large buffers/and or natural slope breaks or flow path interception would greatly reduce erosion and sedimentation to peatlands which otherwise could reduce their size and function.

Effects to Municipal Watersheds

Due to the unlikelihood of any measurable direct, indirect or cumulative negative effects to the project area streams there would no cumulative effects resulting in reduced water quality to the two municipal water sources found in Mission Creek and Meadow Creek.

Summary of Environmental Effects

The effects of the proposed actions on water quality would include the reduction of sediment delivery to project area streams through the prescribed actions of reconstruction, blocking/decommissioning and storing project area roads and improving riparian area shading through natural recovery (decrease in water temperature) in the riparian areas. This improvement is also seen in the reduction of road densities which reduces the number or road/stream interactions and altered hydrology. Water quality is expected to improve with the action alternative. There are no negative impacts to water quality associated with the proposed harvest and burn activities.

Watershed function would also improve in upon completion of this project. Alternative 2 may be a benefit by a better probability for decreased fire severity and disrupting large fire growth in the eventuality of a wildland fire. A large high-severity wildfire in the project area would have negative consequences to aquatic resources for decades. The action alternative, considering past a proposed vegetation treatments with harvesting and road activities would likely not have a measureable impact on water yield and peak flows. Stream channels shown to be stable and resilient to flow fluctuations would remain stable and would not likely erode due to water yield fluctuations.

The action alternative would comply with the Forest Plan, the Clean Water Act, State Water Quality Laws, and all other pertinent regulatory framework.

Compliance with the Forest Plan and Other Relevant Laws, Regulations, Policies and Plans

Idaho Panhandle National Forests Plan

Alternative 2 meets the requirements of the IPNF Forest Plan for water resources and Aquatics. The reduction in sediment delivery, reduced risk of road failures, improved aquatic organism passage in Wall Creek and protection of RHCAs would all benefit aquatic resources. The hydrology project file contains information regarding compliance with specific forest plan goals, objectives, guidelines and standards.

Clean Water Act, Including State of Idaho Implementation

All alternatives would be consistent with the requirements of the Federal Water Pollution Control Act as amended by the Clean Water Act, 33 U.S.C. §1251. Water temperature would not increase in the listed stream segments within the project area as a result of the implementation of any alternative or any of the foreseeable actions. The areas within the project area that are identified as shade deficit segments in the TMDLs will continue to grow and mature thus providing additional shade over time. Through implementation of INFS, BMPs and the net sediment reduction that would take place, risks to beneficial uses designation for support of cold water biota, primary contact recreation and salmonid spawning in project area creeks and tributaries would be reduced by implementation of either of the action alternatives.

Idaho Forest Practices Act

Best Management Practices or soil and water conservation practices would be applied under the action alternative, and all activities comply with the guidelines in the soil and water conservation handbook. A recent audit of BMPs pertaining to water quality indicates the USFS averaged 99% compliance with BMP rules since 1996, and identifies that BMPs are effective when properly installed (IDEQ 2016).

Idaho Stream Channel Protection Act

All alternatives would be consistent with the requirements of this act. INFS criteria incorporates specific protections for stream channels, and is included in this project.

Executive Orders 11988 and 11990

All alternatives are consistent with these EO's regarding floodplains and wetlands. This project proposes no development within wetlands or floodplains. Further, INFS criteria incorporates specific protections for these areas, and is included in this project.

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